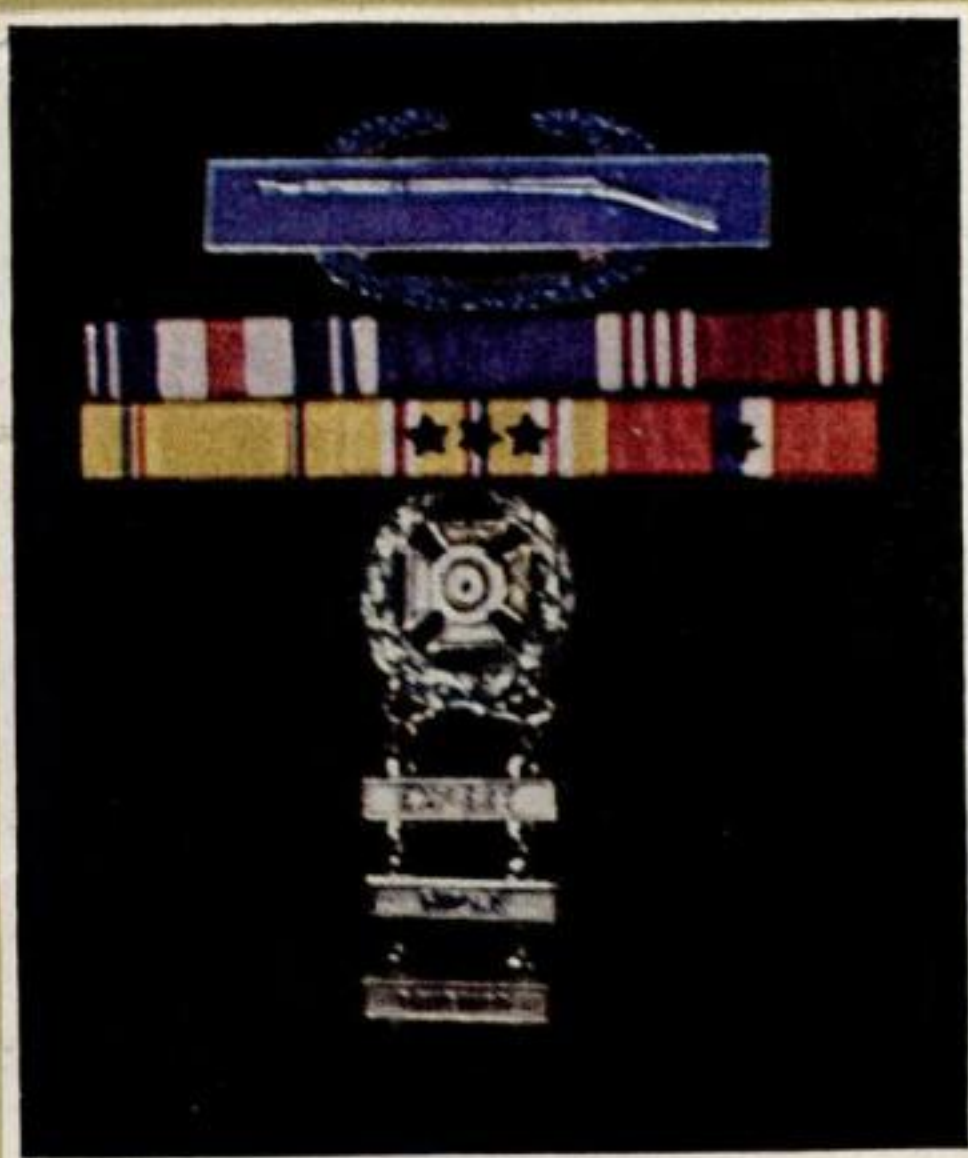


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(continued from opposite page)

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VOL. 147 NO. 3

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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MAJOR GEORGE F. ELIOT (Page 91), whose military background stems from the first days of World War I, has become one of America's leading military and political analysts. He served on the western front in the First World War and returned to active duty with the Military Intelligence Division, War Department, in the recent conflict.

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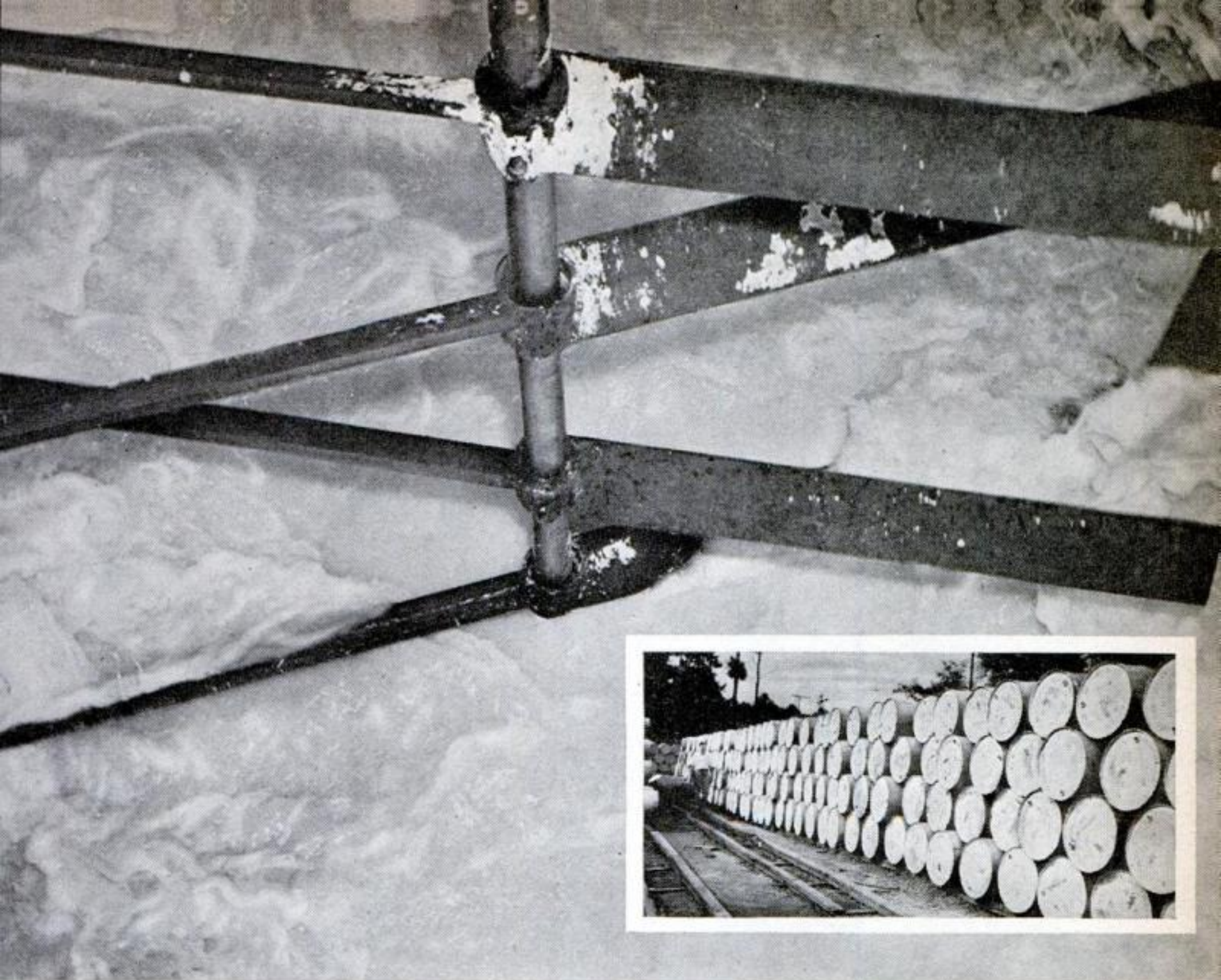


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## Soap from pine trees helps make better tires

*Another example of "building for today, testing for tomorrow"*

**I**N THE large vat above, and in the barrels awaiting shipment, is more soap than most people will use in a lifetime. But nobody is going to bathe with it. It will be used in making synthetic rubber for tires—a new kind of synthetic rubber developed by B. F. Goodrich.

Some sort of soap is used in making all types of synthetic rubber. Until recently it was soap derived from animal fats. The new soap shown here is made from rosin that comes from pine stumps. This different soap makes a definite improvement in rubber.

Tires made from the new rubber give more wear than tires made from ordinary synthetic. They run cooler . . . and this is important, because heat destroys rubber. It's doubly important in big truck tires, which often get as hot as boiling water.

The new rubber was developed several months ago, and made in plants operated for the government by B. F. Goodrich. It was used in military tires, and was kept a military secret. Then it was released for use in heavy truck tires. Now it is going into passenger car tires made by B. F. Goodrich.

This is only one of dozens of improvements that B. F. Goodrich has made since offering the first tires containing synthetic rubber ever sold to motorists in America—in June 1940. All these improvements are indications of the kind of extra value, extra safety and extra wear you get whenever you buy a B. F. Goodrich tire. *The B. F. Goodrich Company, Akron, Ohio.*

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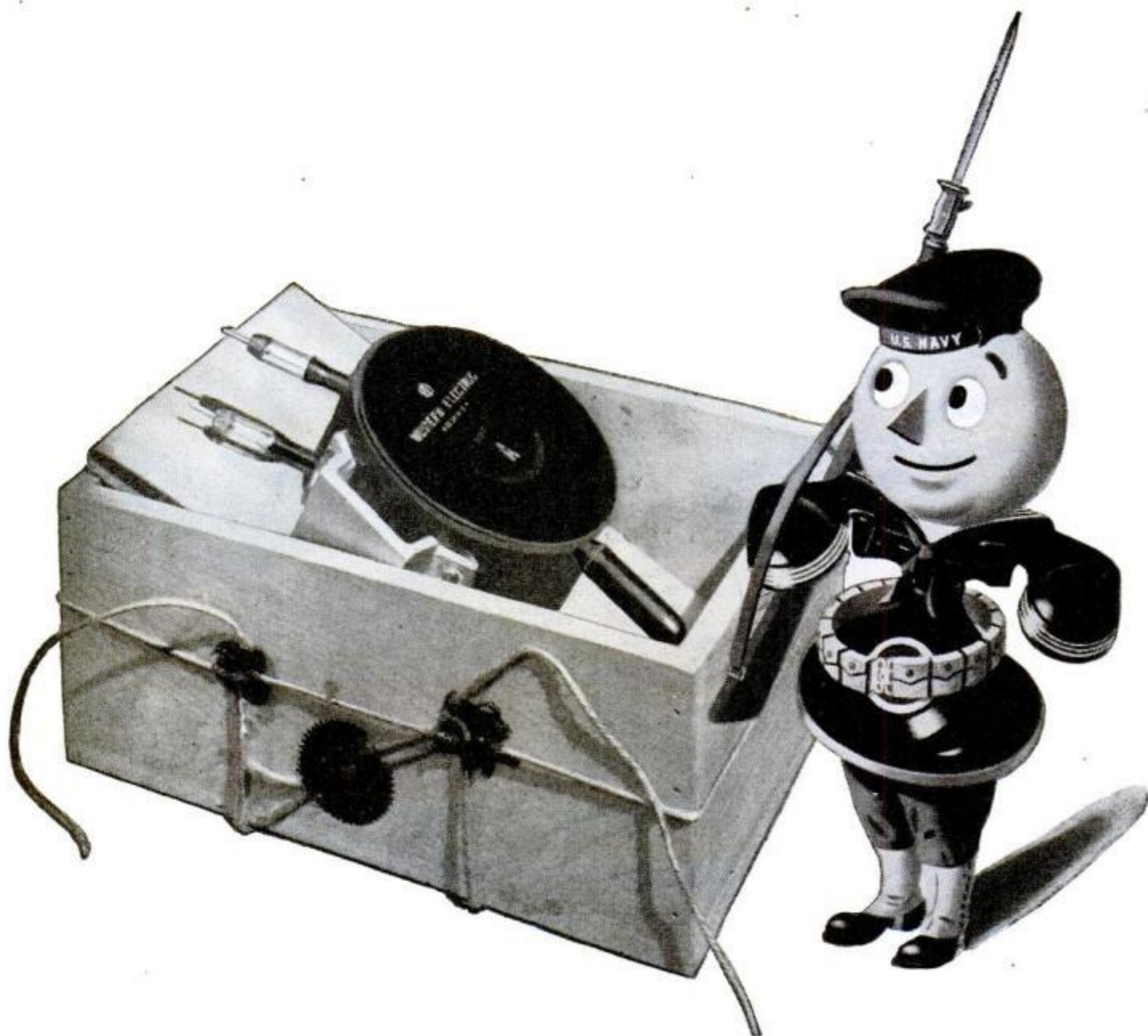
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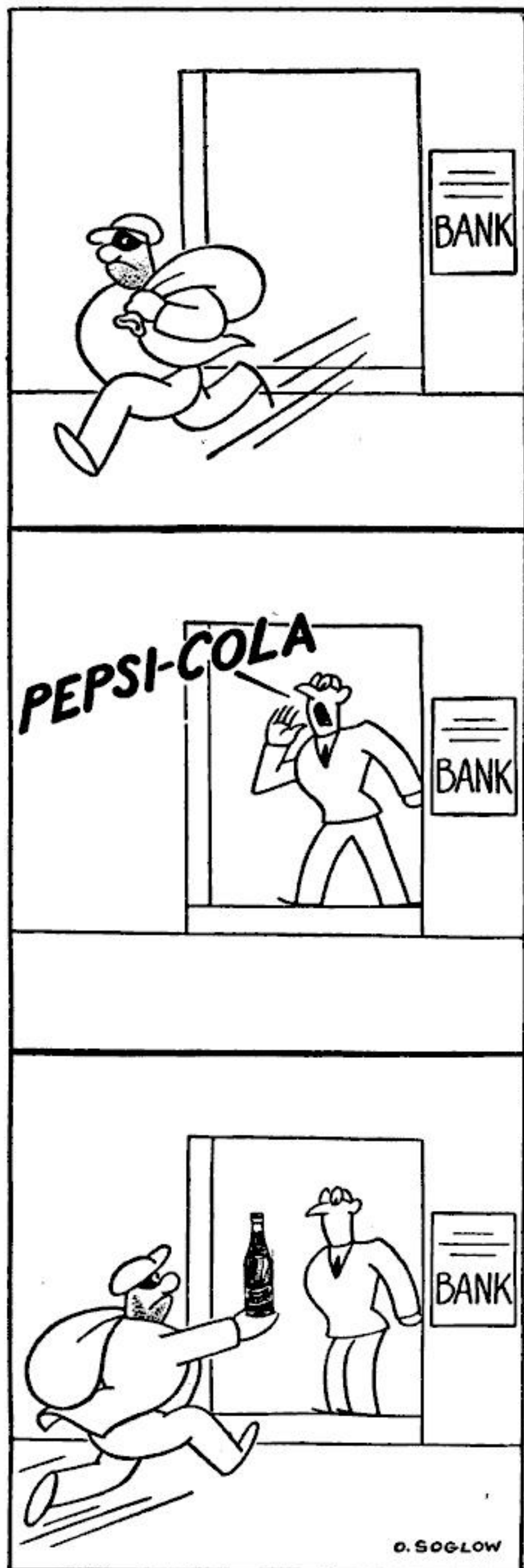
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It would mean more money—those unpaid bills would be taken care of—the children would have more advantages—there would be travel, recreation, social activities.

George had been a fine, loyal employee for twelve years—doing his assigned tasks well—hoping by faithful service to win some day an executive position with his company.

Now all of these hopes were being swept away—as in a dream he heard his chief continue—“You see, George, in these days it is ability to produce that counts. You’re not ready to take on the bigger job—you have made no preparations which would enable you to fill it properly. The man who is going to get that job is Martin. He has been with us only four years, but during that time he has not only been studying the relationship of his department to

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"I was a barber and not working steadily. After about 30 lessons in your Course, I came with Sears Roebuck and now run their radio service shop here, at a nice steady income."—**NORMAN P. FORNOFF**, 1923 E. 13th St., Davenport, Iowa.



You get Radio **EXPERIENCE** building real Radio Circuits with kits of standard parts I send. You get solid **KNOWLEDGE** of Radio, Television, Electronic fundamentals from my easy-to-grasp lessons. You follow the same "50-50" method that helped hundreds of beginners make \$5, \$10 **EXTRA** a week in spare time while learning . . . and prepared them for full time Radio jobs at good pay.

#### Future for Trained Men Is Bright

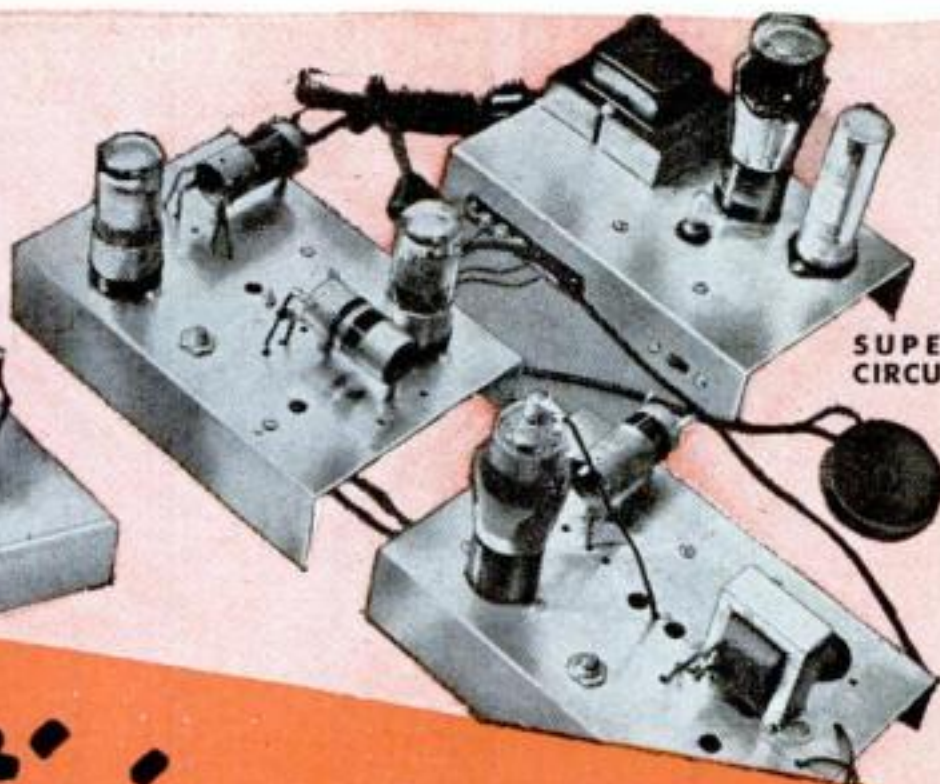
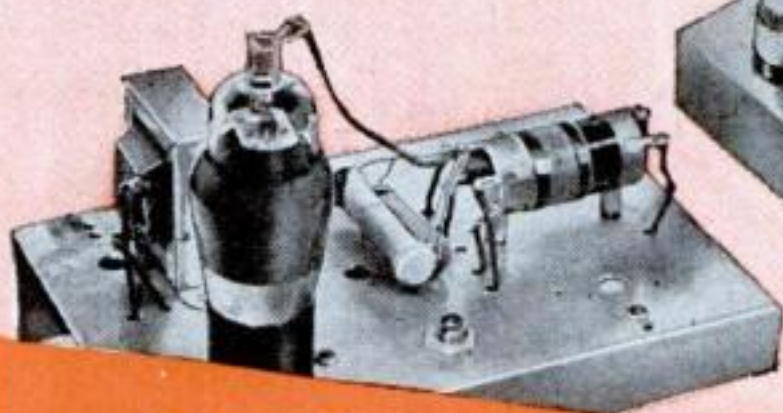
##### in Radio, Television, Electronics

The Radio Repair business is booming **NOW**. There is good money fixing Radios in your spare time or own full time business. And trained Radio Technicians also find wide-open opportunities in Police, Aviation and Marine Radio, in Broadcasting, Radio Manufacturing, Public Address work, etc. Think of the boom coming

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You build this **MEASURING INSTRUMENT** yourself early in the Course—use it for practical Radio work on neighborhood Radios to pick up **EXTRA** spare time money!



You build this **SUPERHETERODYNE CIRCUIT** that brings in local and distant stations. You get **practical** experience putting this set through fascinating tests!

# by Practicing in Spare Time

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now that new Radios can be made! And think of even greater opportunities when Television, and Electronics are available to the public! Get into Radio NOW.

**Many Beginners Soon Make \$5, \$10 a Week EXTRA in Spare Time**

The day you enroll I start sending **EXTRA MONEY JOB SHEETS** to help you make **EXTRA** money fixing Radios in spare time while learning. You **LEARN** Radio principles from my easy-to-grasp Lessons—**PRACTICE** what you learn by building real Radio Circuits with the six kits of Radio parts I send—**USE** your knowledge to make **EXTRA** money while getting ready for a good full time Radio job.

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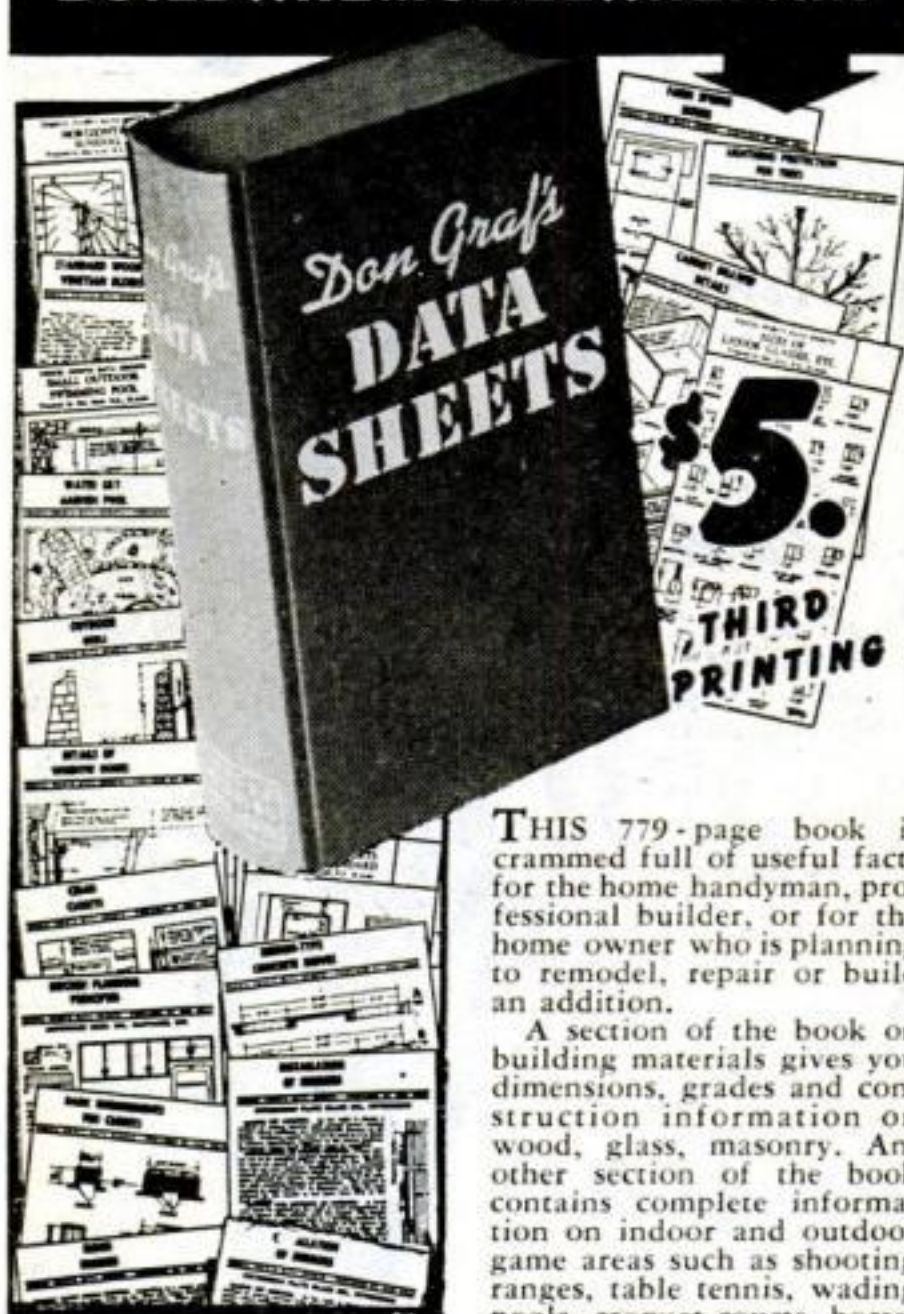
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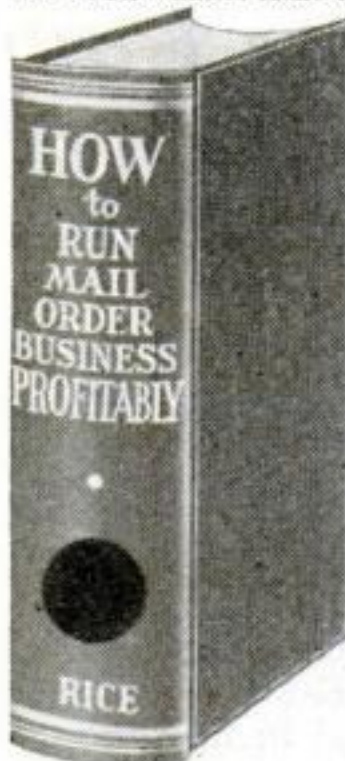
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Modern prospectors made these finds through reading an article in *Popular Science Monthly* for February. Here are L. E. Leipold, Minneapolis school principal, and his son, with a 400-pound chunk of jade valued at \$4,000 and a white sapphire said to be worth \$2,000, both found in central Wyoming.

### Acting on Popular Science Hint, Father and Son Go Prospecting

I HAVE always had an idea that jade is some mysterious substance such as petrified sea foam, worked on by the Chinese for generations in order to prepare something for display in American museums. That it existed in rough form never occurred to me until I read your article in *P.S.M.* for February. My 12-year-old son Darel read it at the same time, and our trip to Wyoming began to materialize. Planning a summer's trip is so much more interesting during the cold winter months.

Our trip was everything that a vacation should be. We visited Lander, and met many people connected with the jade trade. We camped in the mountains; we walked the old Oregon Trail; we killed rattlesnakes; we got lost, got wet, got cold, got thirsty, got hot and tired. But every morning we were ready for another day's search. We found jade, various kinds and amounts of it, in addition to many beautiful Sweetwater agates and several fine white sapphires. All

## Readers Say:

in all, it was a fine trip, inspired by *POPULAR SCIENCE*.

Darel is already planning another trip into that region next summer to prospect for gold. A mining engineer told him that "thar's gold in them thar hills," and Darel wants to get his share. Fifty-dollar ore is a real enticement. And I can't very well let a boy his age go alone, can I?—L. E. Leipold, Principal, Nokomis Junior High School, Minneapolis, Minn.

### Wonderful What You Can Do with a Sock and a Tin Hat

ON THE hot islands of the Pacific many of us soldiers have found a means of cooling drinking water merely through the process of evaporation. You suspend a wool sock in a helmet of water, and put a canteen in the top of the sock. It is surprising to note that within an hour's time the drinking water in

the canteen has become several degrees cooler. The water in the helmet we use may be hot, but that in the canteen will be cool and pleasant to drink. This process also works satisfactorily with cokes, beer, or other bottled drinks.—Lt. A. W. G., APO., San Francisco, Calif.



### Here's a New Idea for Joining Up Sewer Pipes

IN THE May issue of *P.S.M.*, a reader says the method of joining two cast-iron pipes is crude. This may be so. It is true that lead shrinks while cooling. Well, why not use something that expands while it cools? Type metal, for instance, which is part lead and part antimony and expands as it solidifies. (I have not tried it.) I am not a plumber, but a draftsman at the U. S. Naval Gun Factory. C. M. W., Chevy Chase, Md.



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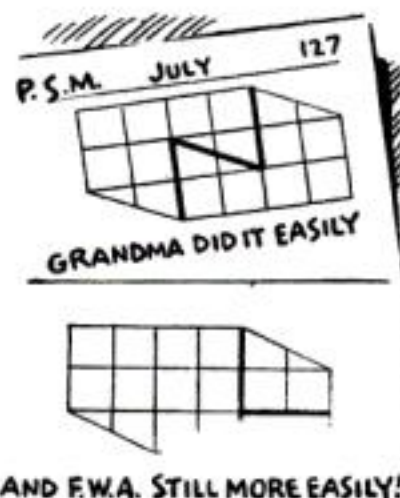


Jerry, the talking dog, is entertaining hospitalized veterans, by courtesy of the PYROIL Company.

## Readers Say:

### Granny Could Have Saved Herself Work

IN THE five brain teasers (P.S.M., July '45, p. 127), there's one that makes me suppose that grandmother has a lot of time on her hands. She could have cut the remnant with two straight cuts of her trusty snippers, as shown, and it would have resulted in less sewing. — F. W. A., West Hartford, Conn.



### How U. S. Battleships Are Classed by Name

ON PAGE 82 of your March issue you talked about the *New Jersey* class battleships. In all the books I have read, they are referred to as the *Iowa* class battleships. A friend told me about this.—L. C., Brooklyn, N. Y.

Congratulations to you and your friend for your keen eyes in pouncing on a technical slip, which first appeared in a Navy press release of December 13, 1944. Since such releases are usually notable for their accuracy, we passed along the statement. In response to our further inquiry, the Navy Department officially settles the question once and for all. (1) The battleships in question are of the *Iowa* class, not the *New Jersey* class. (2) Each battleship or other vessel receives an identifying number at the time that the group is designed. Members of our 45,000-ton class of battleships bear the numbers 61 to 66. The rule is that a class takes its name from the first number, which in this case is *Battleship No. 61, the Iowa*. (3) As it works out, the first ship of a class to be completed is usually—but not always—the one for which the class is named. It simply happens that the *Iowa* is both.—Ed.

### Don't Let This Man Down; Tell Him How to Recoat

I HAVE on hand a Ross Rapid Computer that has lost all of the enamel and I have not been able to have it recoated. How can I do the job myself? I have been a reader for nearly 40 years, and have not been disappointed yet.—L. M. S., San Francisco, Calif.



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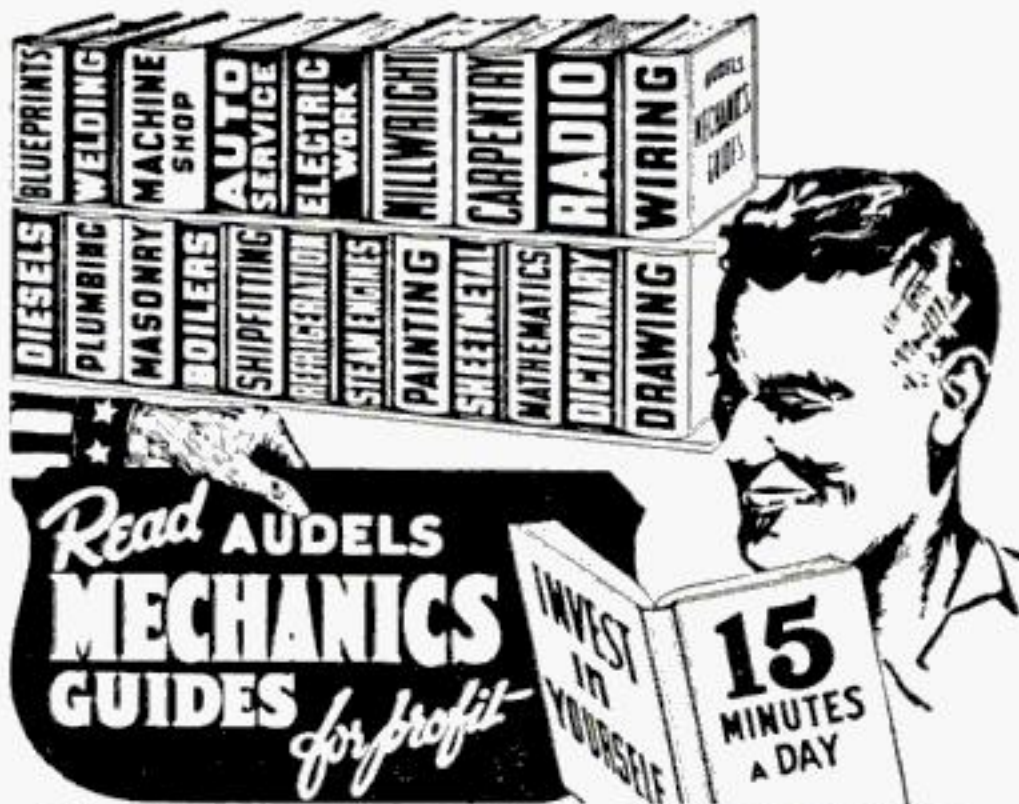
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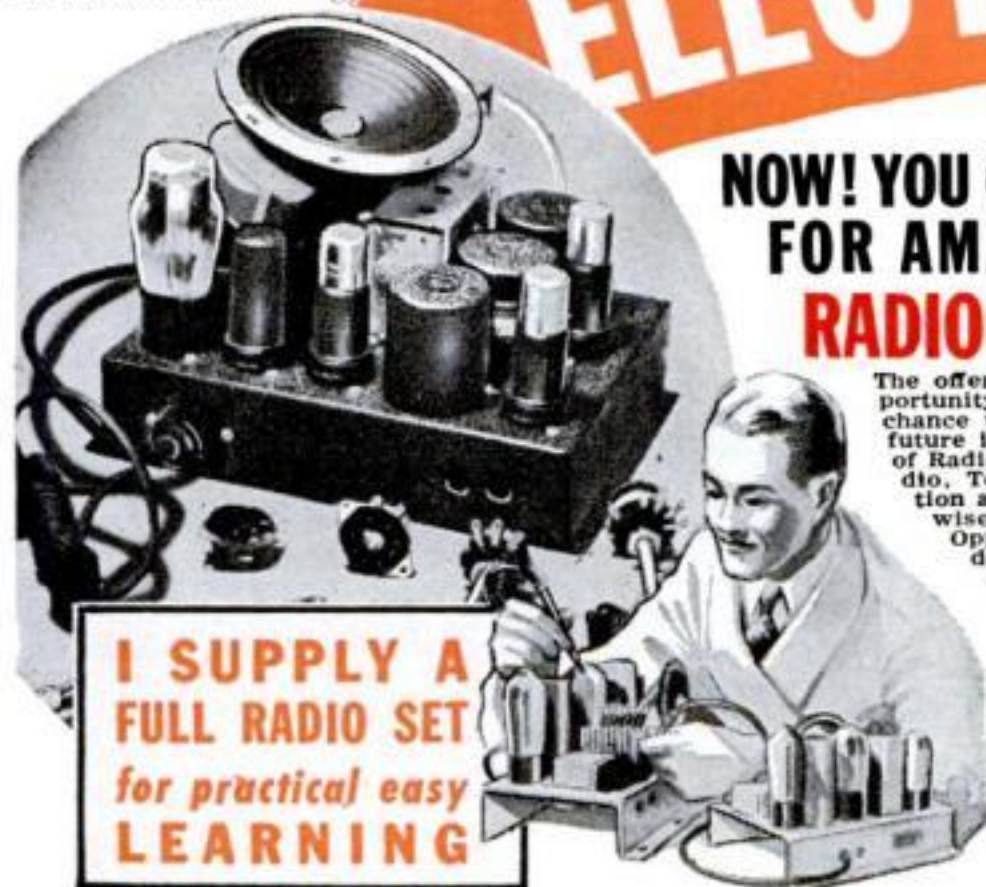
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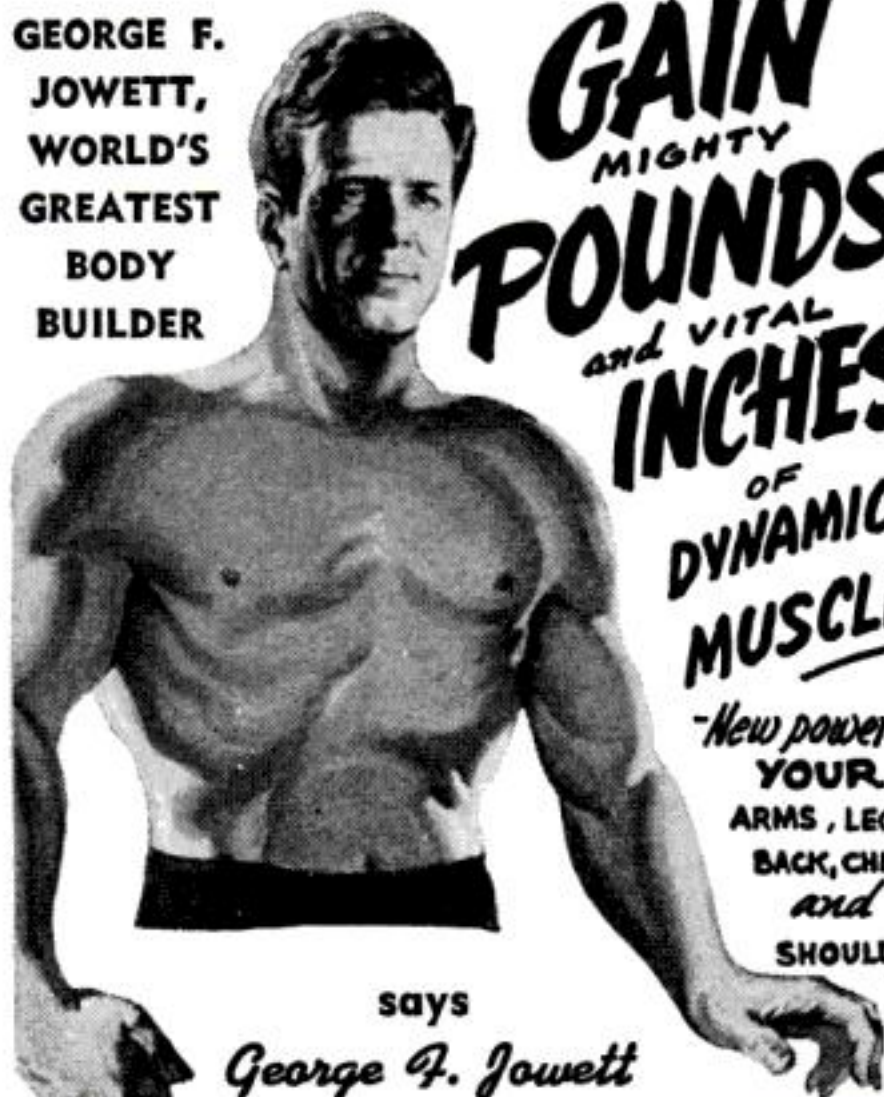
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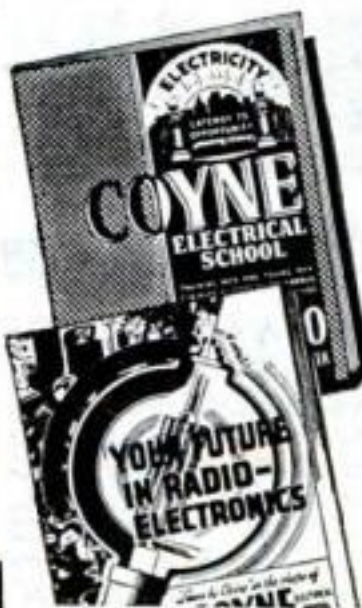
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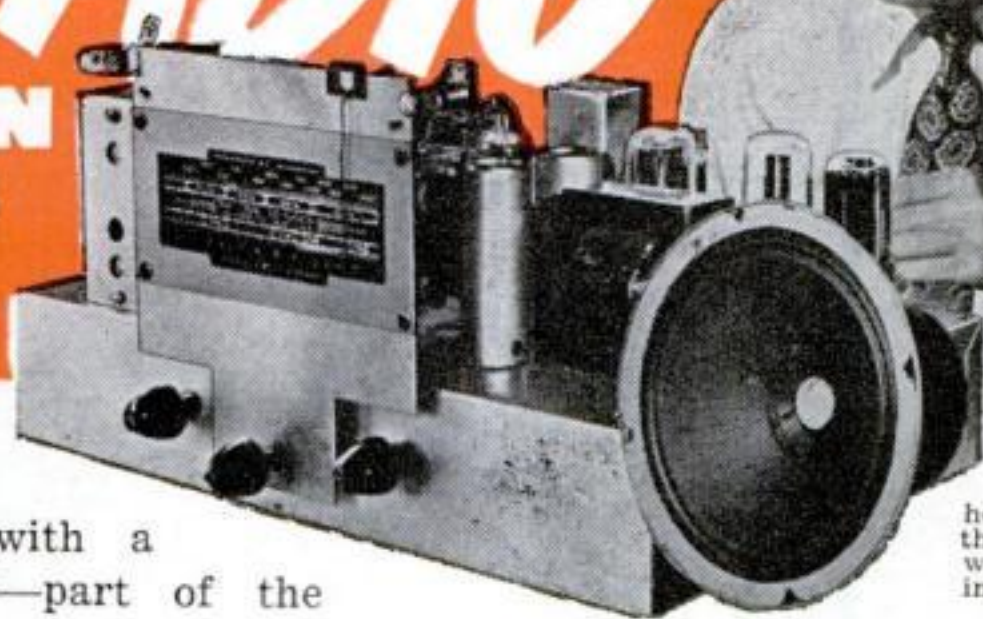
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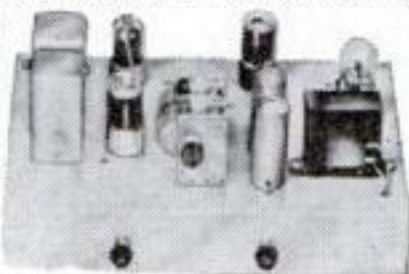
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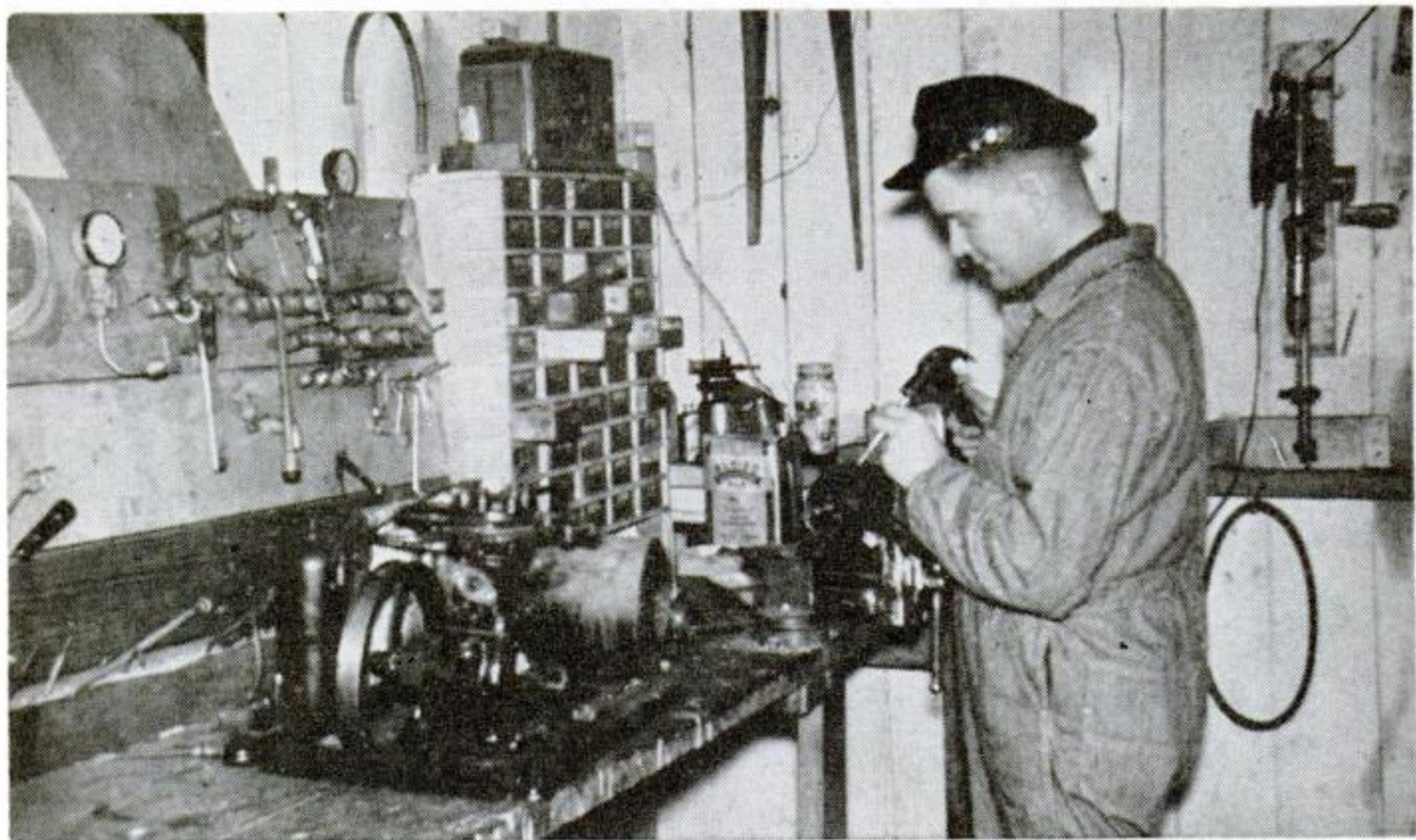
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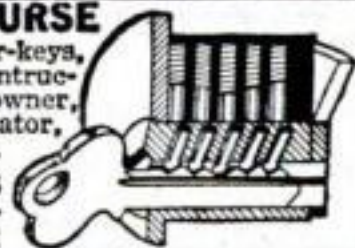
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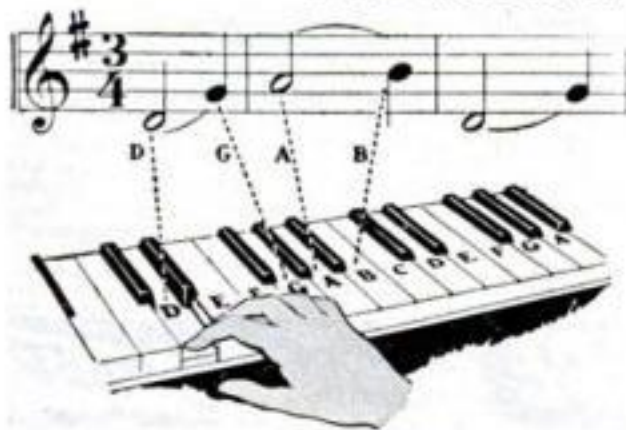
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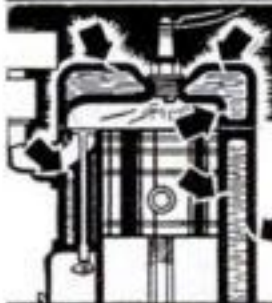
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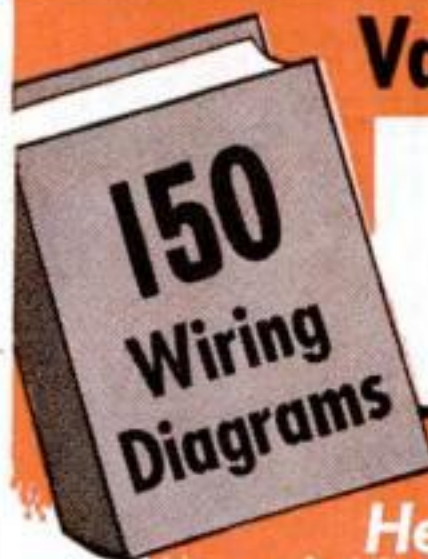
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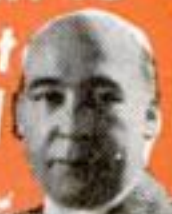
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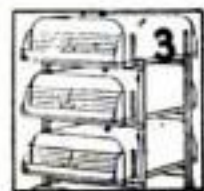
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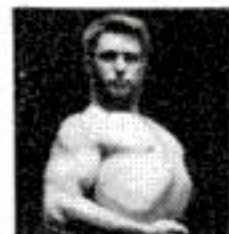
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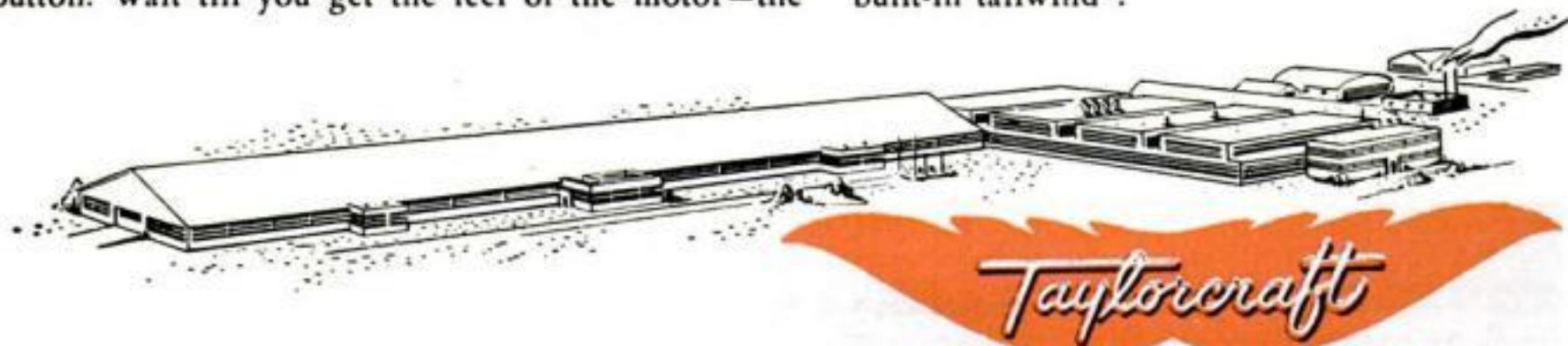
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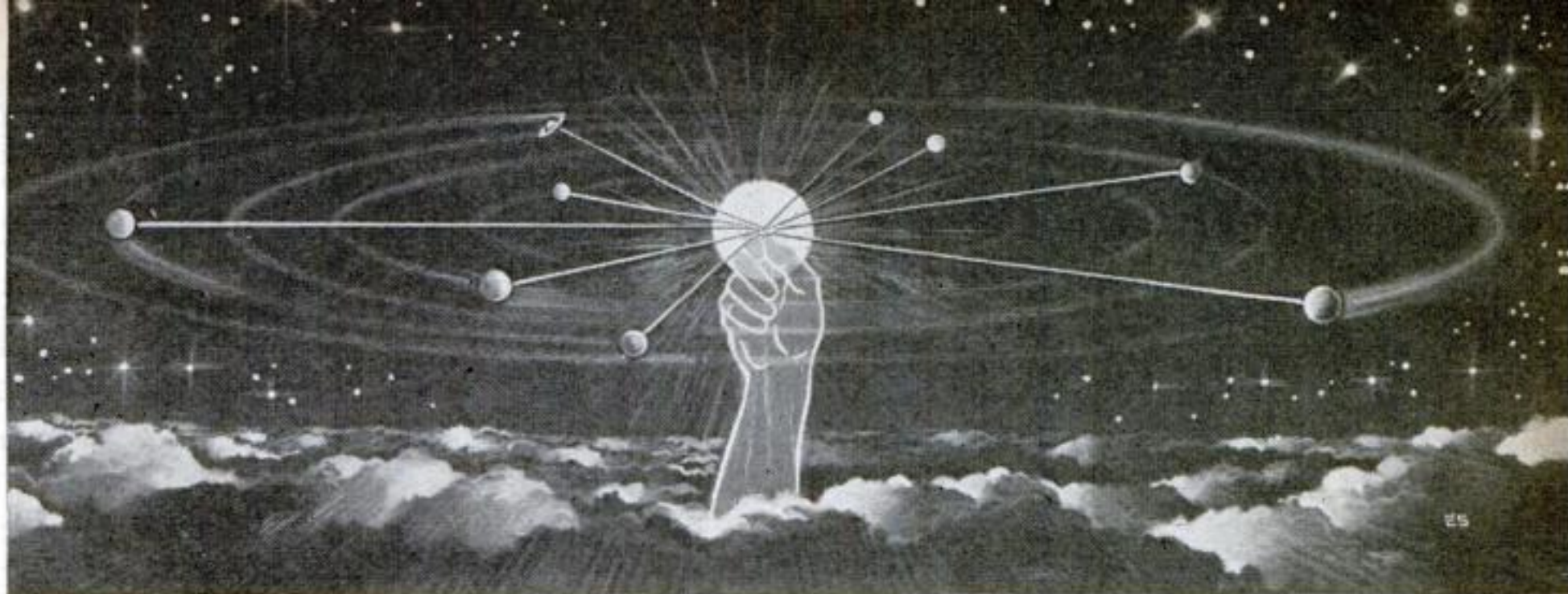
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Revolving around the core of the atom are vastly smaller electrical particles, and spinning around them is a "milky way" of more electrical particles held by forces of gravity in the manner of the solar system.

## WHAT NEXT WITH THE ATOM?

**Can we put the atom's energy to work for the good of mankind?  
Britain's Professor Low says we will, and it will bring miracles.**

By PROF. A. M. LOW

Prof. A. M. Low, president of the British Institute of Technology, designed and built the first radio-controlled robot plane. A pioneer in television, he is the author of many books on scientific subjects.

**S**O WILD have been the statements about splitting the atom that the public must wonder how to distinguish fact from fiction. The division is not easy in a world in which flying has been developed from a dangerous jump of a few yards, only 40 years ago, to regular Atlantic crossings. Nearly all facts are still a matter of opinion and time. Many of the claims being made now have no bearing upon our times; some centuries elapsed

before mankind was able to utilize the power of steam. But when we hear that the earth may be disintegrated, and that gasoline, coal, and oil are things of the past, it is time to take notice.

Is this discovery likely to solve any of the terrible problems which face everyone today?

Atoms are very complex. They are the "bricks" from which all matter is made, and their size is such that if a lump of sugar were magnified to the dimensions of a skyscraper the pattern of these "bricks" still would scarcely be detectable. What is even more interesting—and it is useful to review these simple facts before dealing with any future applications of atomic power—is that every atom is itself com-

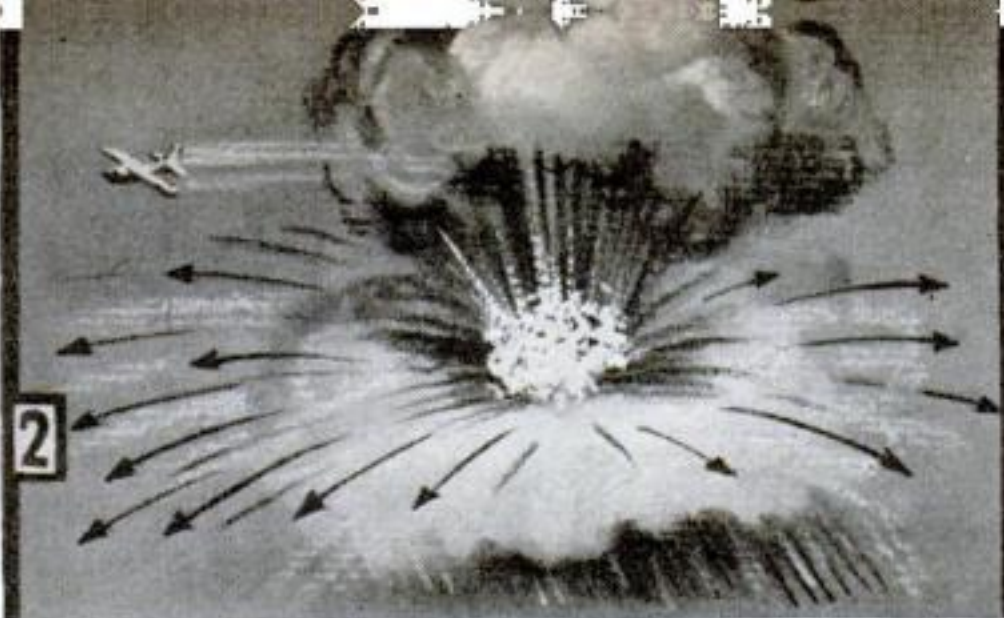
Imagine one of these particles (or planets) breaking loose (an atom splitting). It would fly in all directions, breaking up more, each in turn releasing energy that would destroy everything in its vicinity.







Will man control the weather? A hurricane whips up its fury, ready to spread destruction upon everything that lies in its path.



An atom-bomb-carrying plane flies above the swirling winds, drops its power-laden package into their midst, and disrupts them. This weather control may not be far off.

posed of vastly smaller electrical particles with some kind of hard core which carries nearly all the weight.

Around this core is a "milky way" of electrical particles closely resembling the planetary system. The sun, moon, earth, and various other heavenly bodies of the atom are held in their places by vast forces of gravity acting between them with almost inconceivable power. This energy apparently was put into the atom during its existence as star matter, a period of time inconceivable to the human mind.

Forget, for a moment, this question of size. It is unimportant whether atoms are small or large. Imagine the particles revolving endlessly, but held in place like stones swung around by hand at the end of a string. Now picture the string breaking. Take away the "moon," and what would happen? The remainder of the system would become unbalanced, its particles (or planets) would fly in all directions, breaking up more as they went, and each in turn releasing energy until the total value of this energy would be so high that the resulting heat would destroy everything in its vicinity. That, with a little imagination and license, is what happens when an atom splits.

The first machines for accomplishing this were exceedingly cumbersome, needed powerful magnetic fields, and served mainly

to teach the principle involved. They were unable to do more than impel one particle into the atom's structure and were incapable of dealing with the guarded center of the atom.

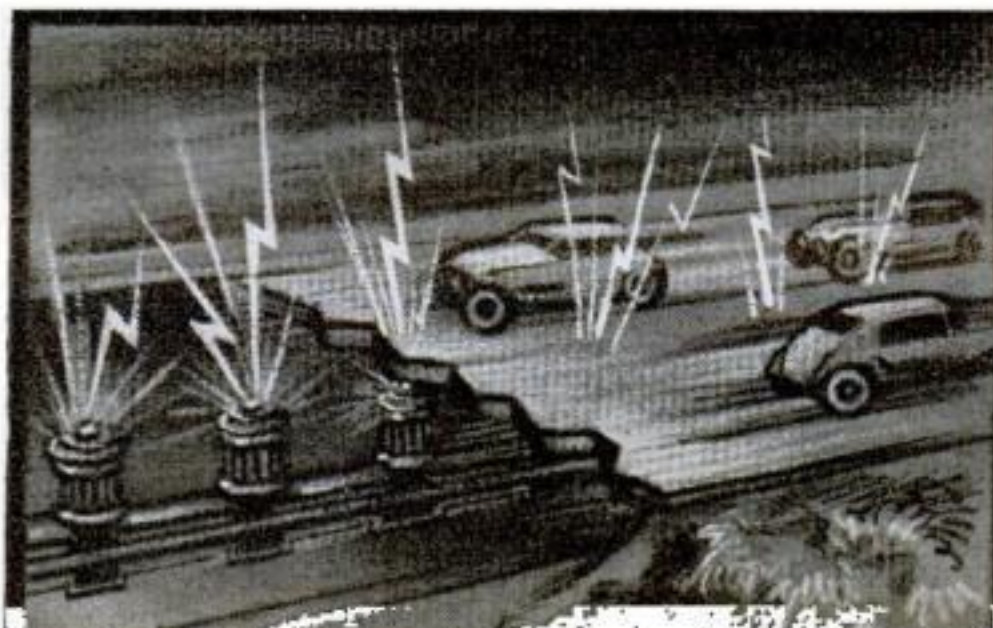
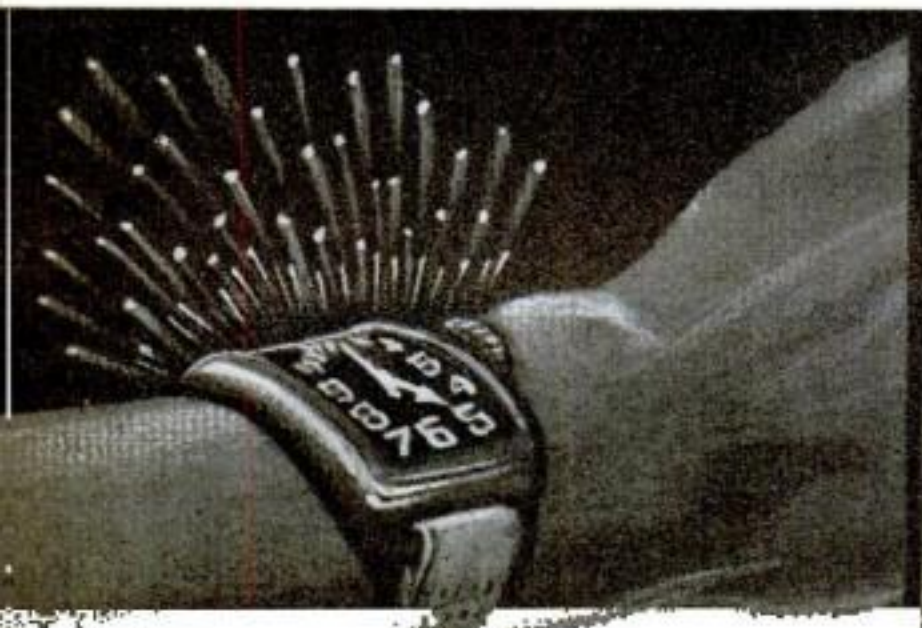
In the new bomb, uranium has been utilized, and the operation consists of triggering off atoms likely to be broken up by bombardment. It is easy to see how this is possible, because an ordinary luminous wristwatch continually throws off light particles which fly from the surface at a speed of many thousands of miles per second, as radium turns in the course of tens of thousands of years into familiar lead.

As in any conventional "explosive," it is the speed of the action that causes effective energy to be obtained. The speed of change brings efficiency, and the problem now is to reduce the explosive change, which takes place in a fraction of a second in the atomic bomb, to a tractable state in which the time period will be days, weeks, or months.

If this cannot be done, the splitting of the atom may be of little more use than the invention of a high explosive a few hundred thousand times as powerful as dynamite. Although dynamite has been employed for many years for destruction and excavation, its use as a source of power has been limited. At present, there is little chance of obtaining atomic power in a form which can be used for commerce, and this is likely

Science is seeking to control the radioactive particles which trigger off a splitting atom the way radium shoots off light particles.

Bringing the exploding specks of energy to a tractable state may mean electrical highways of the future where vehicles could be driven by underground "transformers."





to be true for at least 20 years. If control can be achieved, however, the picture will be very different.

High explosives cannot be used for driving a car. Nor can they be employed as propellants in guns. In an automobile, the explosive is slow; just as in a gun the high explosive is reduced in flame speed. Mixtures of explosives with other materials form such propellants as cordite. In V-2 rockets, control can be easily secured, so that burning, or slow explosion, is applicable to propulsive power.

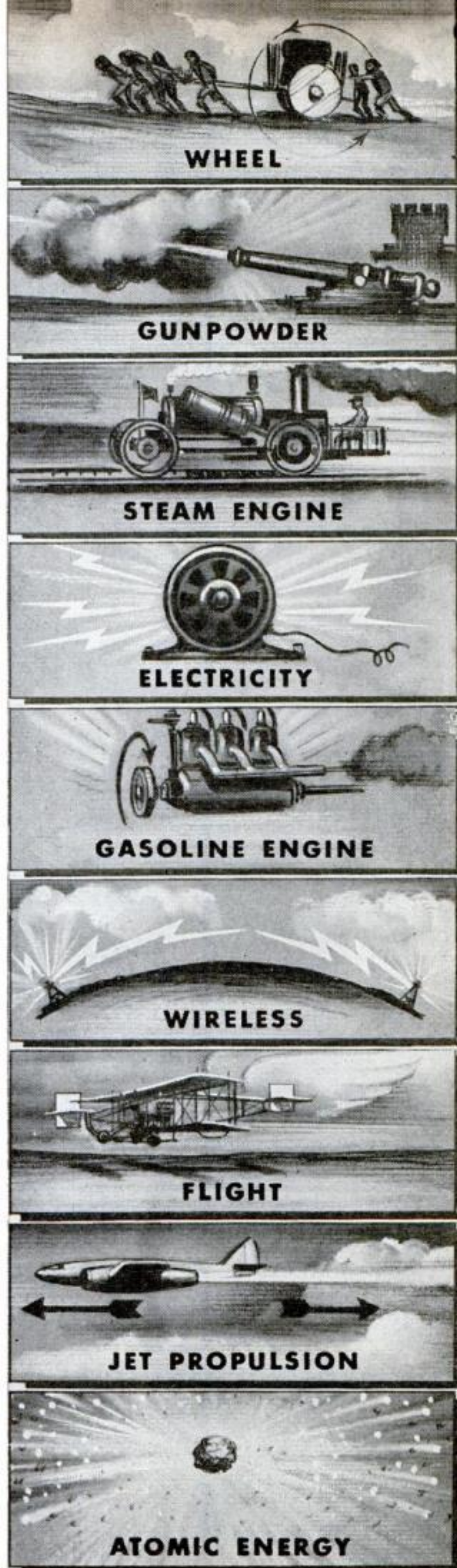
Control of atomic power will bring seeming miracles to the world. The power available from changing matter into energy via the atom is so colossal that we shall be able to afford transmission systems that today would be hopelessly inefficient. But this huge power is not the main point; it is a matter of size and weight. Coal as dust is a good explosive and gasoline is probably more powerful as an explosive than TNT, but in each case the bulk is greater. The atomic explosive releases fundamental forces from a volume so small that making its power available can completely revolutionize the world.

As a weapon, atomic rocket bombs will certainly render all other methods of destruction obsolete in a few years. Rockets undoubtedly will be radio-directed from distances of many thousands of miles. Yet peaceful applications, which must come, may be even more far-reaching. In the air, for example, speeds of 1,000 miles per hour will be commonplace. A journey from London to New York and back in a day is possible even now, but within a few years we shall become accustomed to seeing our friends wearing white ducks on Christmas Day and knowing that they are merely off for a few hours of bathing in Africa.

It is no exaggeration to say that within a century—perhaps far less, if we are willing to spend a small portion of the money which is available for war—visits to the moon will by no means be utterly ridiculous, and there are other possibilities which may be much nearer than we imagine.

Radium, as we have seen, turns slowly into lead. Its particles rearrange themselves very slowly. It is a sudden alteration that causes explosive forces to be released. What then may happen to straying particles before they "settle down?" It seems reasonable to suggest that we may be able to control further reactions and, if this is accom- *(Continued on page 226)*

These nine great steps in civilization helped to win wars, but none helped to prevent armed conflict. Will controlled atomic energy be a power for good?



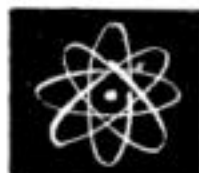


# THE LANGUAGE OF ATOMIC POWER

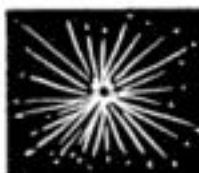
**ALPHA PARTICLES.** The charged cores of helium atoms that are emitted by radioactive materials.



**ATOM.** The smallest bit of matter retaining the properties of a chemical element.



**BETA PARTICLES.** High-speed electrons (charges of negative electricity) emitted by radioactive atoms.



**CALUTRON.** An isotope separator developed at the University of California; a modified form of cyclotron.



**CYCLOTRON.** The apparatus used to bombard atomic targets with particles accelerated in a spiral path.



**DSM PROJECT** (Development of Substitute Materials). The Army code name for the atomic-bomb project.



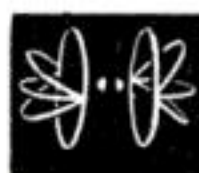
**ELECTRON.** A particle with a negative electric charge moving in an orbit outside the atom nucleus.



**ELEMENT.** A fundamental substance of unique chemical properties. Many have various types, called "isotopes."



**FISSION.** The splitting or disruption of an atom core, forming two or more other elements.



**GAMMA RADIATION.** Highly penetrating rays similar to X rays but of shorter wave length.



**HALF-LIFE.** A measure used for comparing the life of radioactive materials without complete disintegration.



**HEAVY WATER.** Water that contains a double-weight isotope (deuterium) of hydrogen.



**HOT LABORATORY.** A laboratory for remote-controlled work on highly radioactive material.



**ISOBARS.** Forms of two or more different elements that have the same atomic weight.



**ISOTOPES.** Types of an element, distinguishable from each other only by differences in atomic weight.



**MASS SPECTROGRAPH.** The instrument for separating isotopes, or almost identical substances.



**MODERATOR.** Material, such as carbon or heavy water, that slows but does not absorb bombarding neutrons.



**NEPTUNIUM.** One of the newly created radioactive elements. It has an extremely short life.



**NEUTRON.** Particle in atom core carrying no electric charge. It is useful for smashing other atom cores.



**NUCLEUS.** The core of an atom, which is destructible by a bombardment of neutrons.



**PILE.** A built-up block, in a lattice pattern, of uranium embedded in graphite; used to manufacture plutonium.



**PILOT PLANT.** A small-scale factory where laboratory processes are tested before building a big plant.



**PLUTONIUM.** Newly created radioactive element of comparatively long life. Explodes, releasing atomic energy.



**PROTON.** One of the principal kinds of particles in the atom core. It carries a positive electric charge.



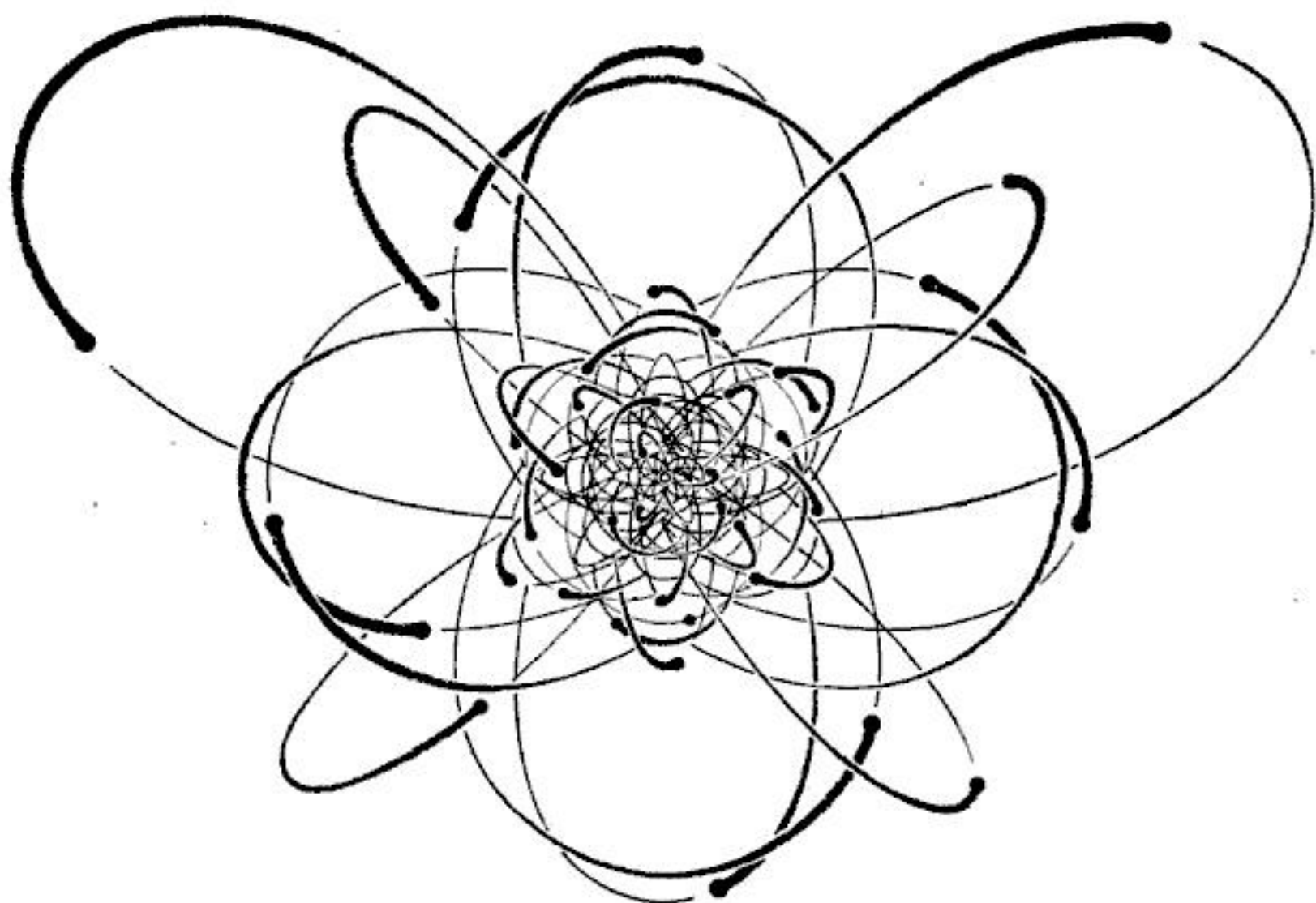
**RADIOACTIVITY.** The spontaneous or artificially produced disintegration of chemical elements.



**URANIUM.** A metallic element and parent of radium series. Rare "isotope" U-235 releases atomic power.







**ATOM PORTRAIT** of an element of the uranium family. The outer orbits of electrons are easily penetrated, but atomic power can be tapped only by smashing the inner core with projectiles such as neutrons.

## WHAT'S BEHIND ATOMIC POWER?

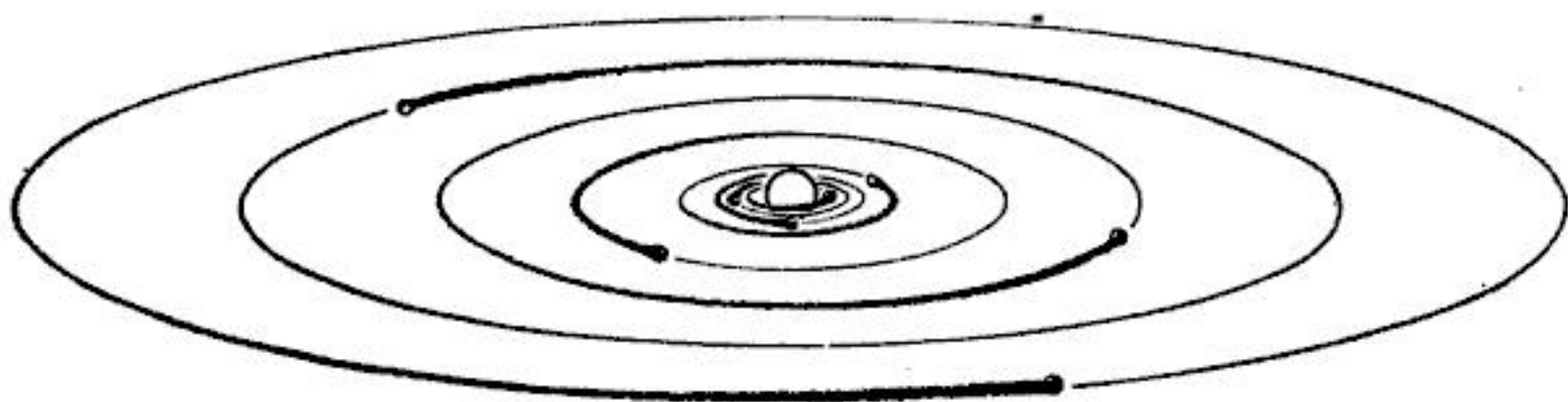
By **ALDEN P. ARMAGNAC**

**B**EHIND the attainment of atomic power, already realized in the awesome missiles dropped on Japan and expected within the next generation to be tamed for peaceful use, lies a story of secret research unparalleled in drama. Now the War Department permits it to be told to this writer by Dr. H. D. Smyth, head of the physics department of Princeton University.

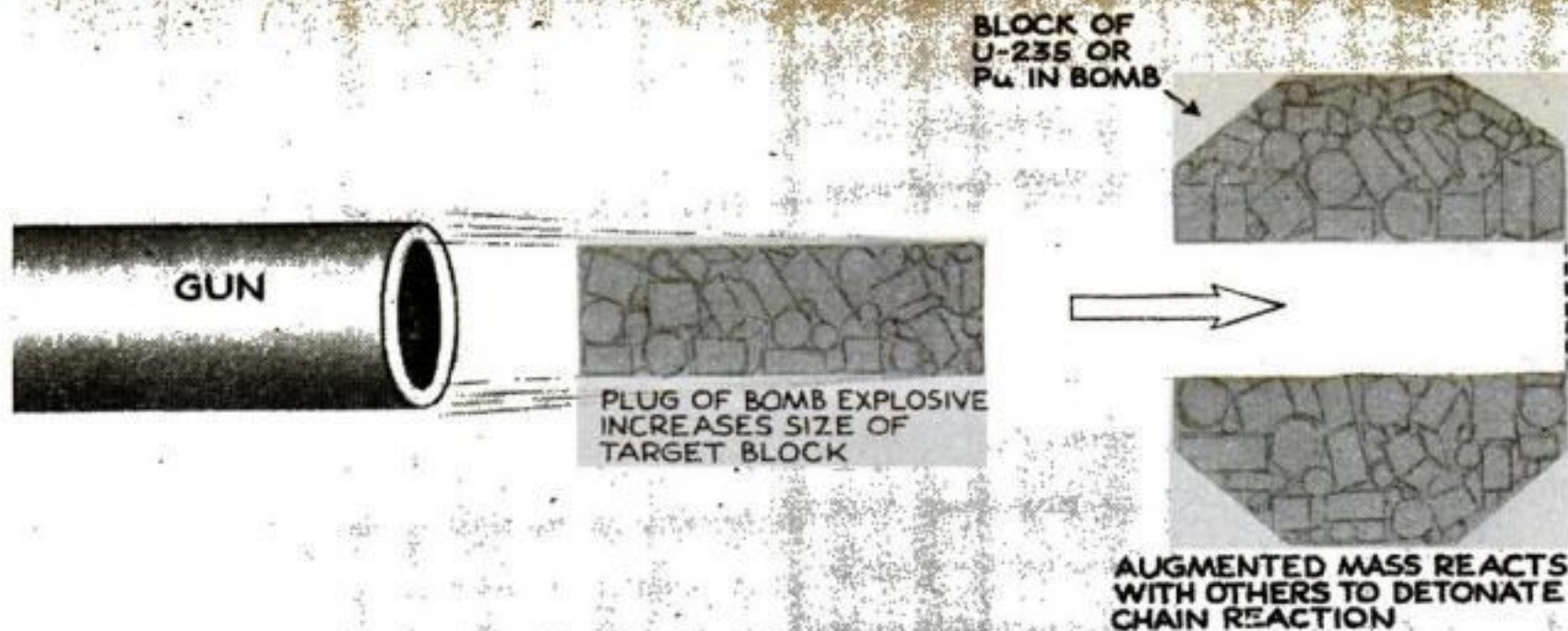
When atom-smashing experiments van-

ished from the headlines, about the middle of 1940, it meant that a "security blackout" guarded an all-out program to tap the energy locked within the core of the atom. At that time, clues were as thick as in a mystery novel. Following the first artificial transmutation of one element into another, by the famed British scientist Lord Rutherford in 1919, his followers rejoiced in the sport of turning long-inviolate elements into

**SOLAR SYSTEM** offers an analogy to the form of an atom, the planets representing the orbits of electrons (negative particles) and the sun the core. Sun's heat and light probably come from chain reaction.







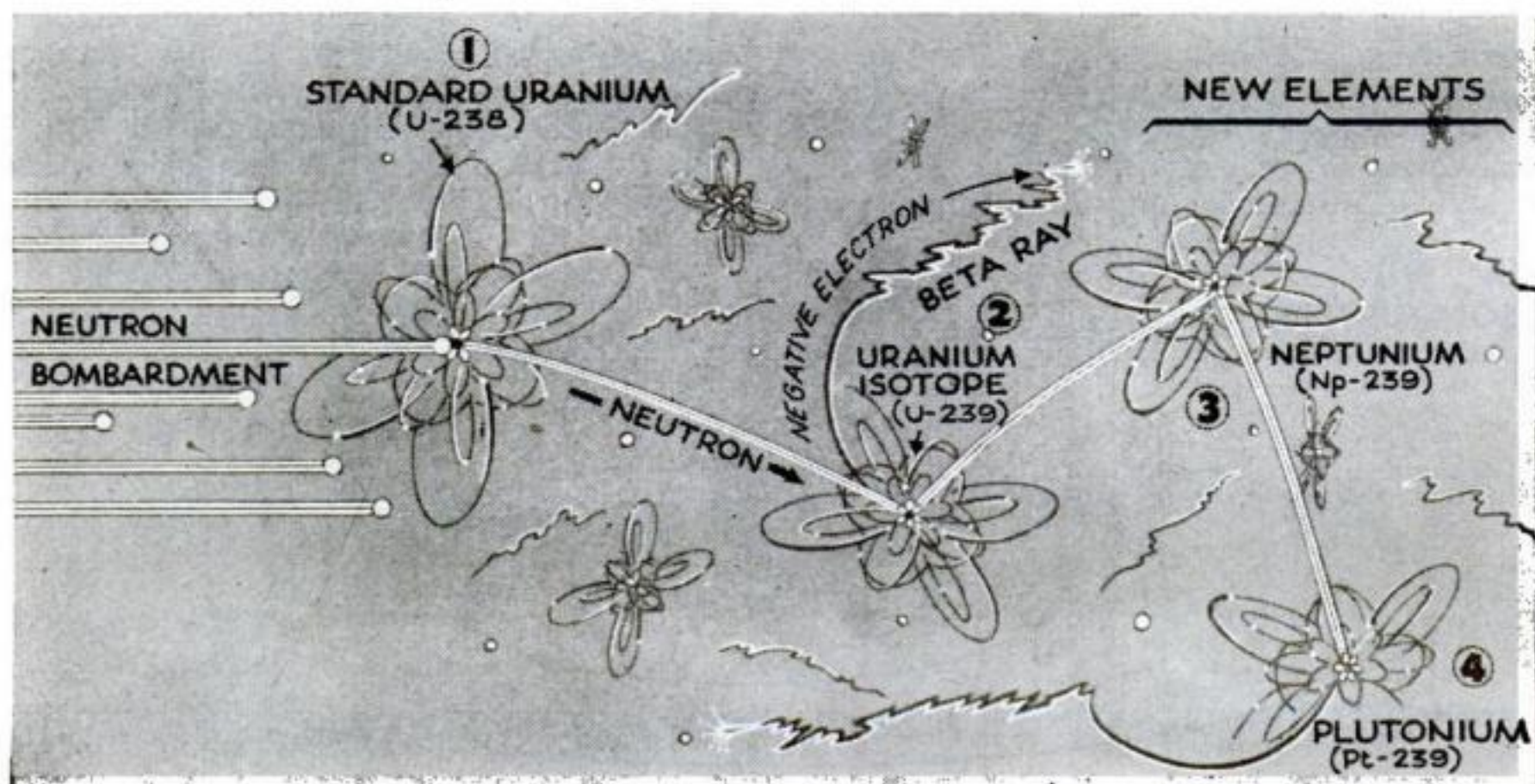
**EXPLODING** an atom bomb. Pieces of U-235 (or plutonium) are so arranged that no chain reaction takes place. Then at the vital moment another piece is introduced into the mass, setting up the reaction.

something else. That elements of precisely the same chemical behavior could have different atomic weights came as an equally astonishing discovery. Production of one of these "isotopes"—double-weight hydrogen, constituent of heavy water—won a Nobel Prize for Dr. H. C. Urey of Columbia University. And the parent element of the radium family, uranium—whose normal weight was 238—turned out to be mixed with an exceedingly interesting isotope of lighter weight, 235.

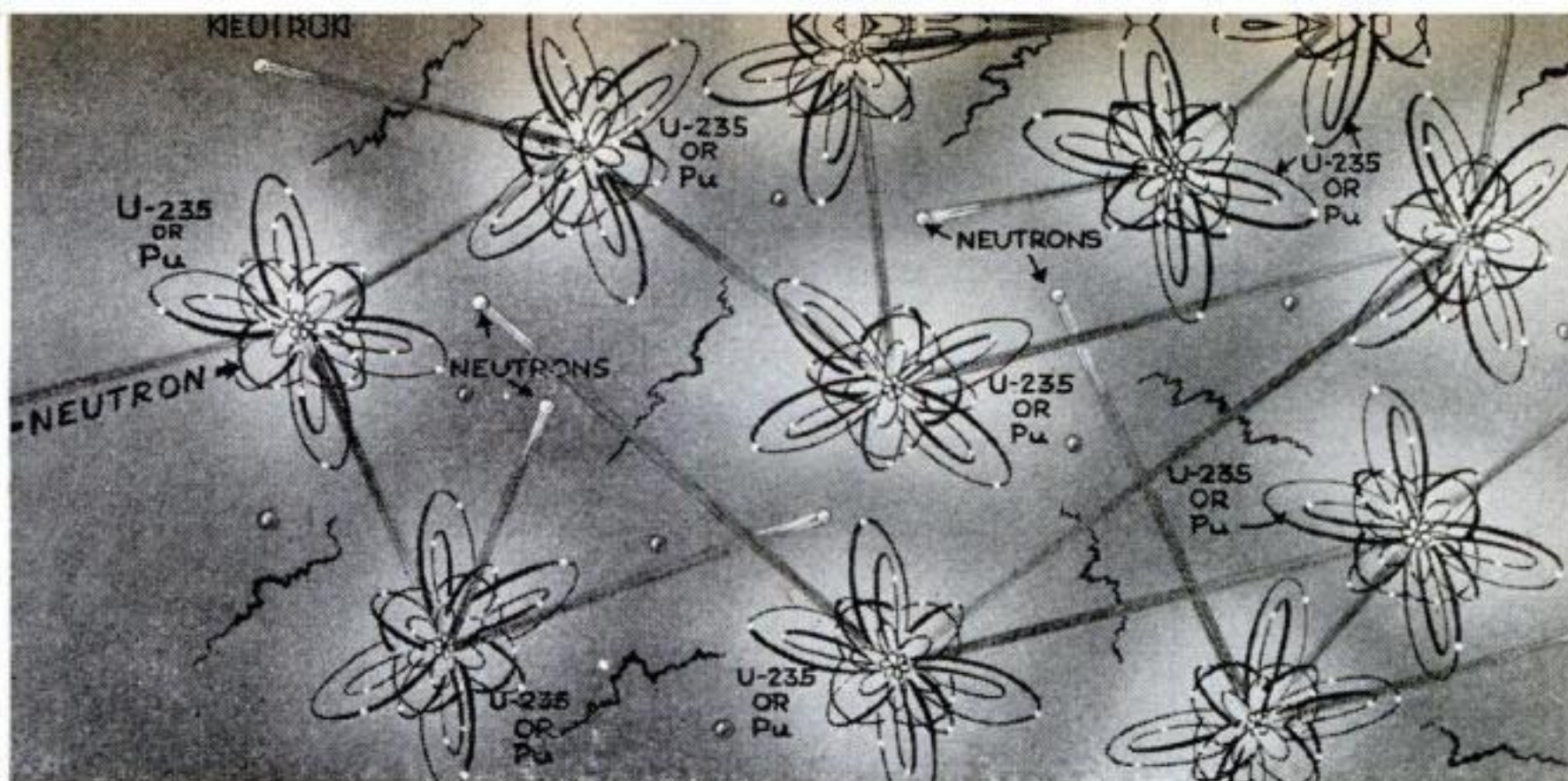
Training their atom-smashers upon U-235, experimenters were amazed to get back more energy than they put in, even though on an infinitesimally small scale. Better yet, several U-235 atoms were sometimes observed to blow up in quick succession,

as if the explosion of one atom shattered another in turn. Could a similar "chain reaction" be produced on a large scale? Calamity howlers cried out that such an attempt might consume the whole world in one cataclysmic explosion. Dismissing their fears, such distinguished American physicists as Dr. Karl Compton conservatively predicted that atomic power would be harnessed within 50 years. As for the practical side, Dr. A. O. Nier, young scientist of the University of Minnesota, produced microscopic quantities of U-235 with a laboratory-sized instrument called a mass spectrograph. (Isotope separator might have been a more informative name.) And that was about the last that the public heard about atomic power until the terrific

**MAKING PLUTONIUM.** Bombarded by neutrons, normal uranium turns into an isotope, U-239, and then into the newly created neptunium and plutonium—the first atomic chain reaction attained by man.







**EXPLOSION.** A stray neutron bombards one atom of U-235, whose fission (splitting) releases other neutrons that blow up next particles. These send off more neutrons until bomb burst reaches its zenith.

blasts at Hiroshima and Nagasaki told the world that the expected work of 50 years had been accomplished in five—a miracle of scientific teamwork with U.S. Army and British collaboration.

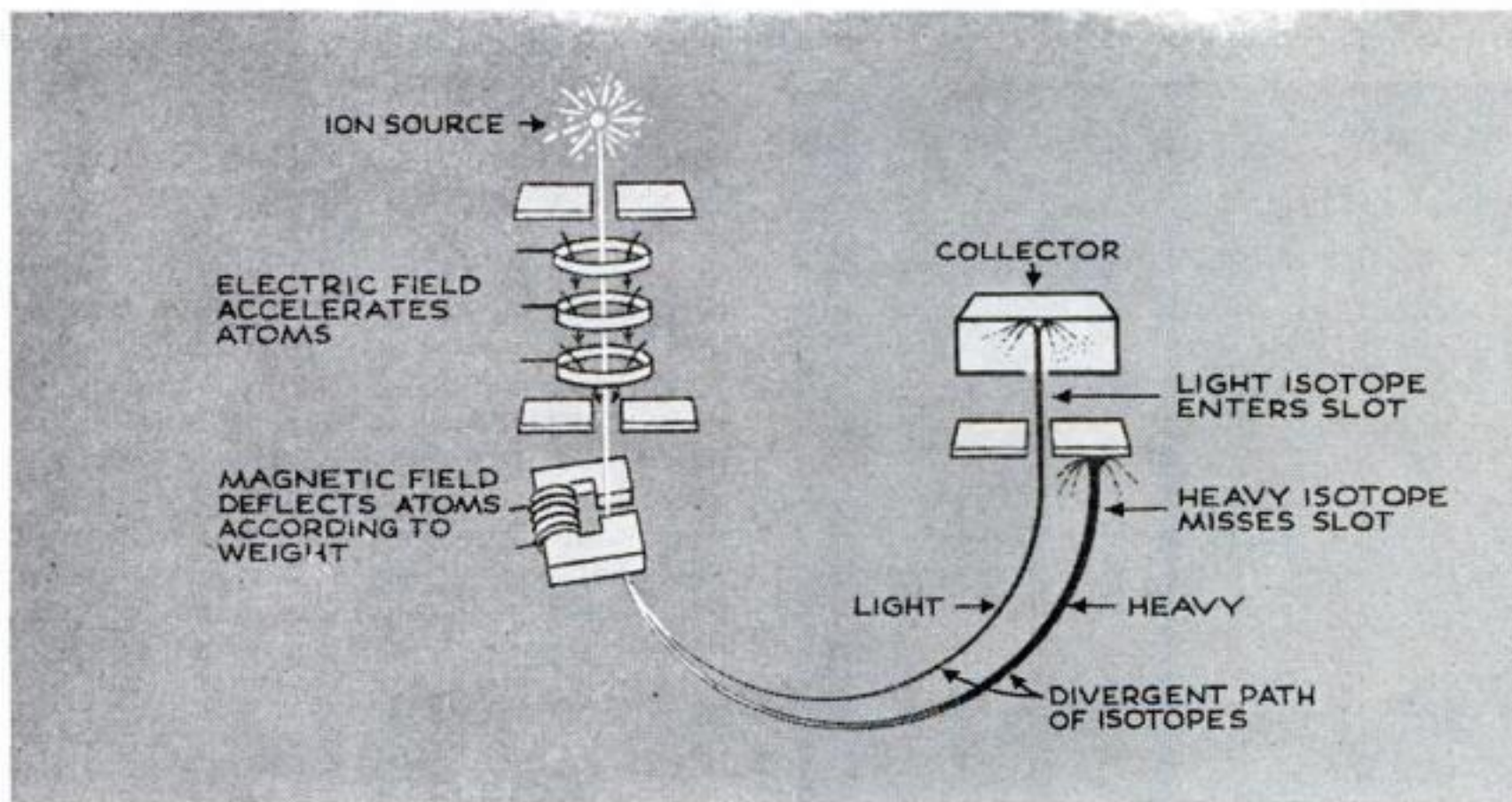
Now for the secrets of the in-between years:

That little mass spectrograph used by Dr. Nier deserves further attention, because it applied in miniature one of the four principal ways to make U-235. By heating the bromide salt of normal uranium, Nier impelled its vapor through a semicircular tube, first through an electric and then through a magnetic path. Accelerated by the electric field, the different isotopes were then deflected according to their weight by the magnetic field. Just at the spot where

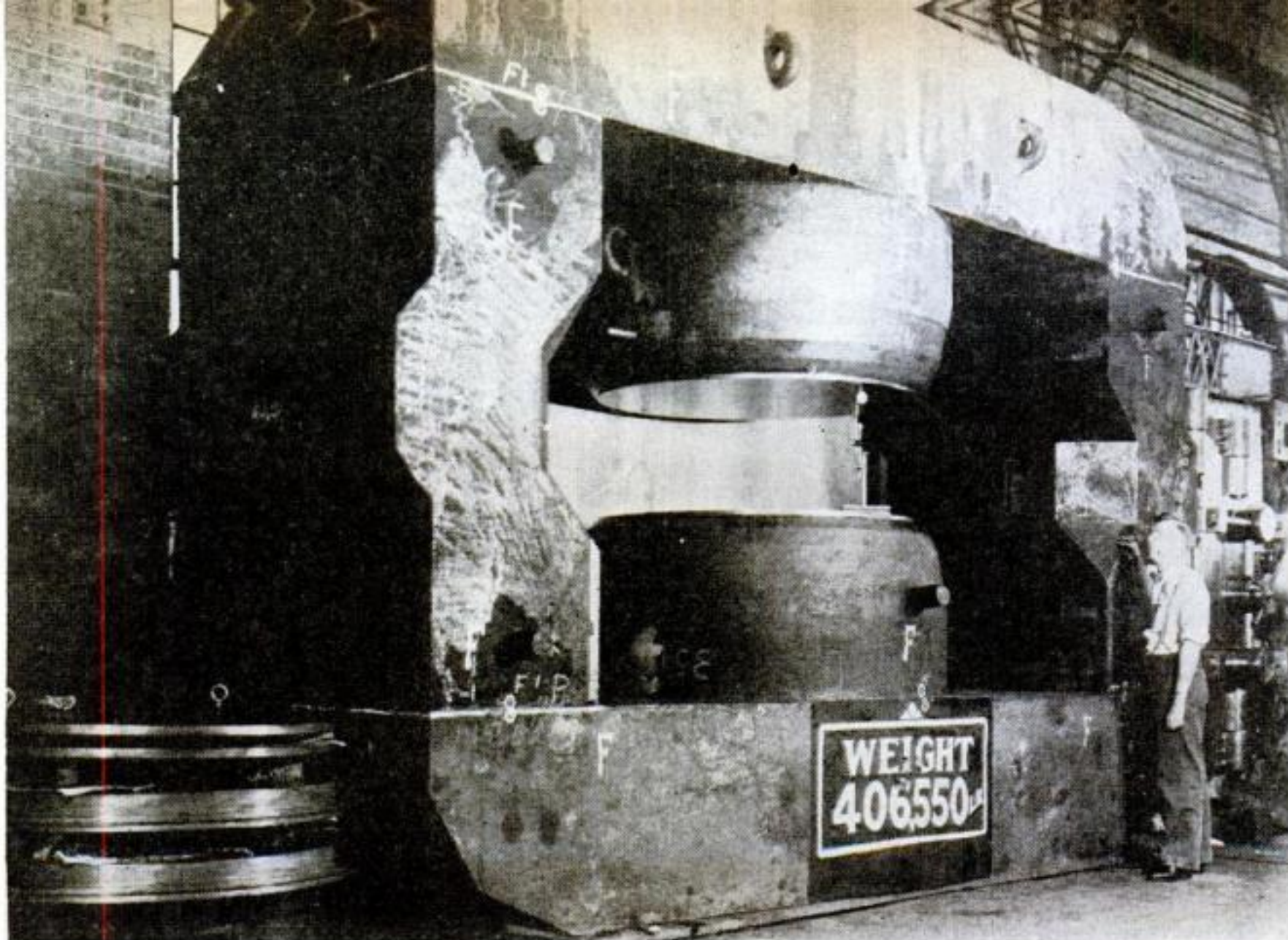
the U-235 would strike, a collector drew it off.

The biggest magnet in the world, intended for a huge uncompleted cyclotron at the University of California, magnified the power of Dr. Nier's tiny instrument untold times. It had a pole diameter of 184 inches. Under the direction of world-famous Dr. Ernest O. Lawrence, inventor of the original cyclotron, the gigantic magnet was built into a piece of apparatus resembling a mass spectrograph in principle, and christened the calutron, after the university. In his enthusiasm, Dr. Lawrence also dismantled his pet 37-inch cyclotron and made a calutron out of that, too. Results were so promising that a giant plant was erected at the Clinton Engineer Works in Tennessee. Its

**MASS SPECTROGRAPH.** Diagrammed below is the instrument that was first able to separate uranium isotopes. This was used as a model in constructing the giant calutrons for producing U-235 in mass form.



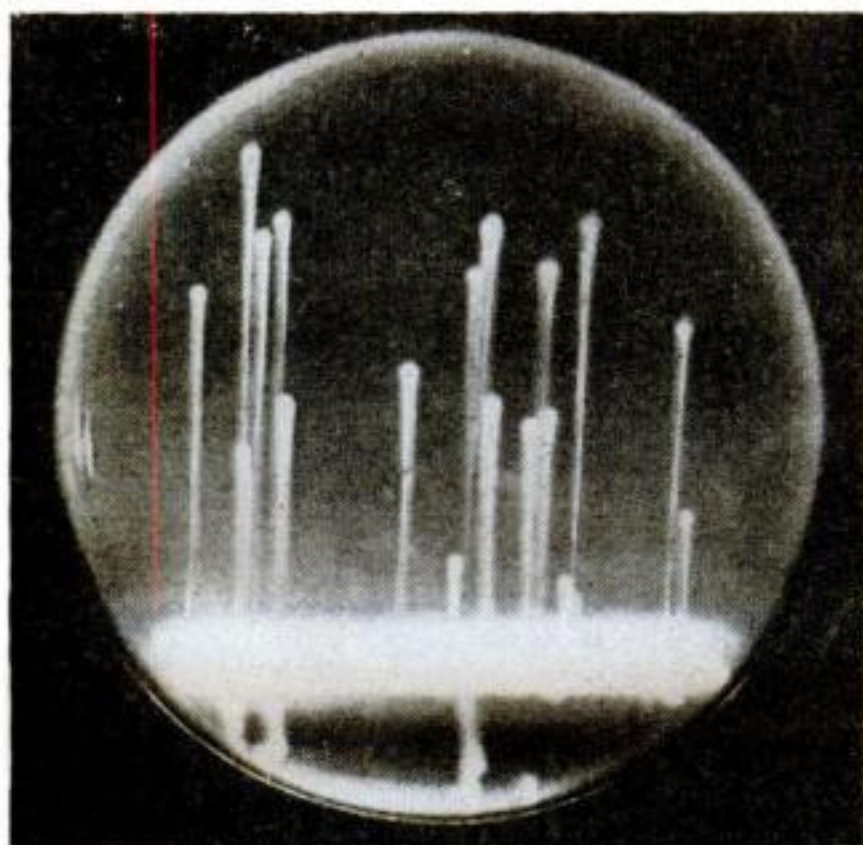




**GIANT MAGNET** gets surfaces and pole faces checked and adjusted at the Mosler Safe Company, where it was machined. Each calutron needed one of these magnets to help in separating the isotopes.

banks of calutrons were in full operation by the winter of 1944-1945, producing U-235 of sufficient purity for use in atomic bombs. Although research started later than with other methods of making U-235, it was the first plant to yield large amounts. Considering the scarcity of natural uranium, and the fact that it contains only one part in 140 of the isotope, U-235, the magnitude

**"ATOMIC POWER GAUGE"** measures energy released by atoms when smashed. Each shaft of light is a gauge of power unleashed by one atom.



of the feat may be appreciated by anyone.

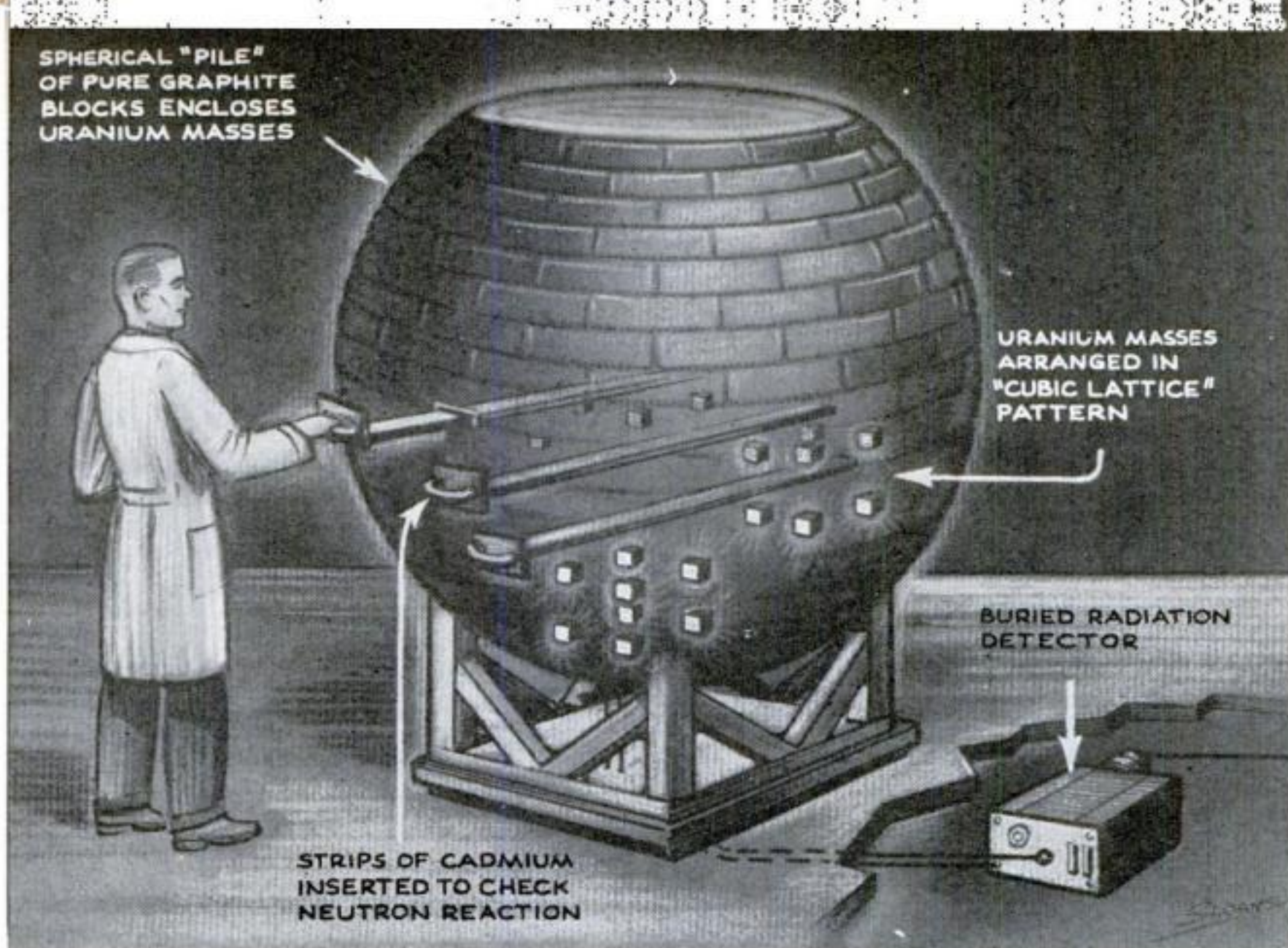
But American and British experts, constantly comparing notes, had taken no chances that the U-235 program would fail, or come to a head too late. Reports from Germany indicated that Hitler had assembled his top-flight scientists in the magnificent physics laboratories of the Kaiser Wilhelm Institute, in Berlin, and set them the task of beating us to atomic power. It was a desperate race against time, with the prospect that the winner might very possibly win the war! So, just as if U-235 had never been heard of, we simultaneously embarked upon a search for another atomic-bomb explosive.

So bold that it rested only on unproved theory, the program called for no less than artificial creation of two new chemical elements. And these unknown substances were to be produced by a chain reaction, which would precede another chain reaction in the bomb itself. Unknown hazards, later to be found real enough, faced the men whose daring brought success on every count.

On paper, the reaction looks easy. Suppose that a neutron, either produced artificially or just straying in space, collides with an atom of normal uranium, U-238. (A neutron is an uncharged particle in an atom's core, as opposed to a proton, which carries a positive electrical charge.)

After momentary creation of an isotope,





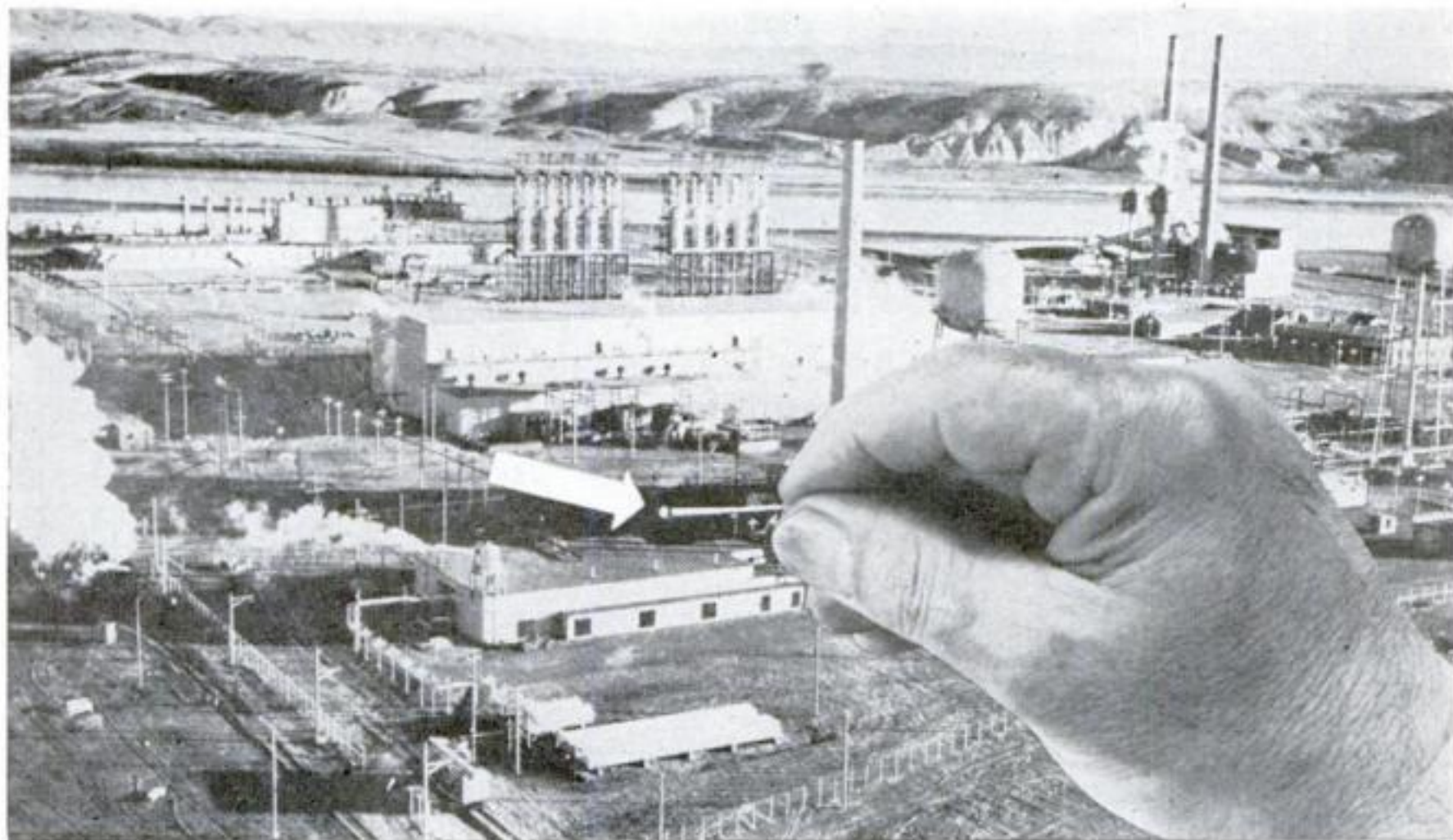
**FIRST CHAIN REACTION** produced by man took place in this "pile" at the University of Chicago. The raw material is uranium, and the product is plutonium. Neutron-absorbing rods control reaction.

U-239, which promptly vanishes, the next product is a short-lived synthetic element named neptunium. Its creation has been accompanied by emission of a negative electron or beta ray. Another electron shoots from neptunium, and it turns into a second,

fairly stable element now known as plutonium. This is the atomic-bomb explosive sought after.

On a squash court beneath an athletic stand of the University of Chicago, as far as possible from [\(Continued on page 210\)](#)

**HISTORY'S BIGGEST GAMBLE.** Here is one of the three great plants erected to mass-produce plutonium after scientists had succeeded in making a pinhead amount. A \$2,000,000,000 gamble we won.







**A SMALL AIRPORT**, outfitted with planes, jeeps, radios, trailers, and other equipment from surplus war stocks, is the postwar plan that won Pvt. Arthur P. Ives, of Fort Benning, Ga., the \$100 first prize in the Popular Science contest.

# How **YOU** Can Use Surplus War Material

**We asked readers to tell us what they planned to do with leftover Army goods. Here's the answer.**

**By HAL BORLAND**

*Drawings by B. G. SEIELSTAD*

**T**HE Biblical injunction to beat swords into plowshares and spears into pruning hooks was fairly easy to follow when wars were fought with swords and spears. But what are you going to do with a General Sherman tank now that it is no longer needed on the battlefield? Of what use is a bazooka to a

peaceful civilian? Those responsible for disposing of several billion dollars' worth of surplus war material would be glad to hear the answers.

They aren't worrying too much about tanks and bazookas, which are relatively unimportant entries on the long surplus-property lists. Take a few lots at random: 39,000 china sugar bowls, 24,000 door pulls, 24,000 jungle kits, 42,800 miscellaneous hand tools, 11,500 kerosene-lantern globes, 2,000,000 laboratory spoons, 500,000 miscellaneous truck and auto parts, 70,000 horseshoes. Go down the line and you see how total the war really was.

Many of the items can be sold virtually out of hand. Most of the clothing, for instance, is almost perfectly adapted for any outdoorsman. Take the Army's battle jacket. Full-cut for freedom, made of multiple-weave poplin, it is warm, roomy, and comfortable. Any jacket that can stand up to jungle weather and barbed wire can laugh at briars and duck



weather. The price of surplus jackets sold through retail stores can only be guessed at, but in the Army post exchanges they sell for \$16.00.

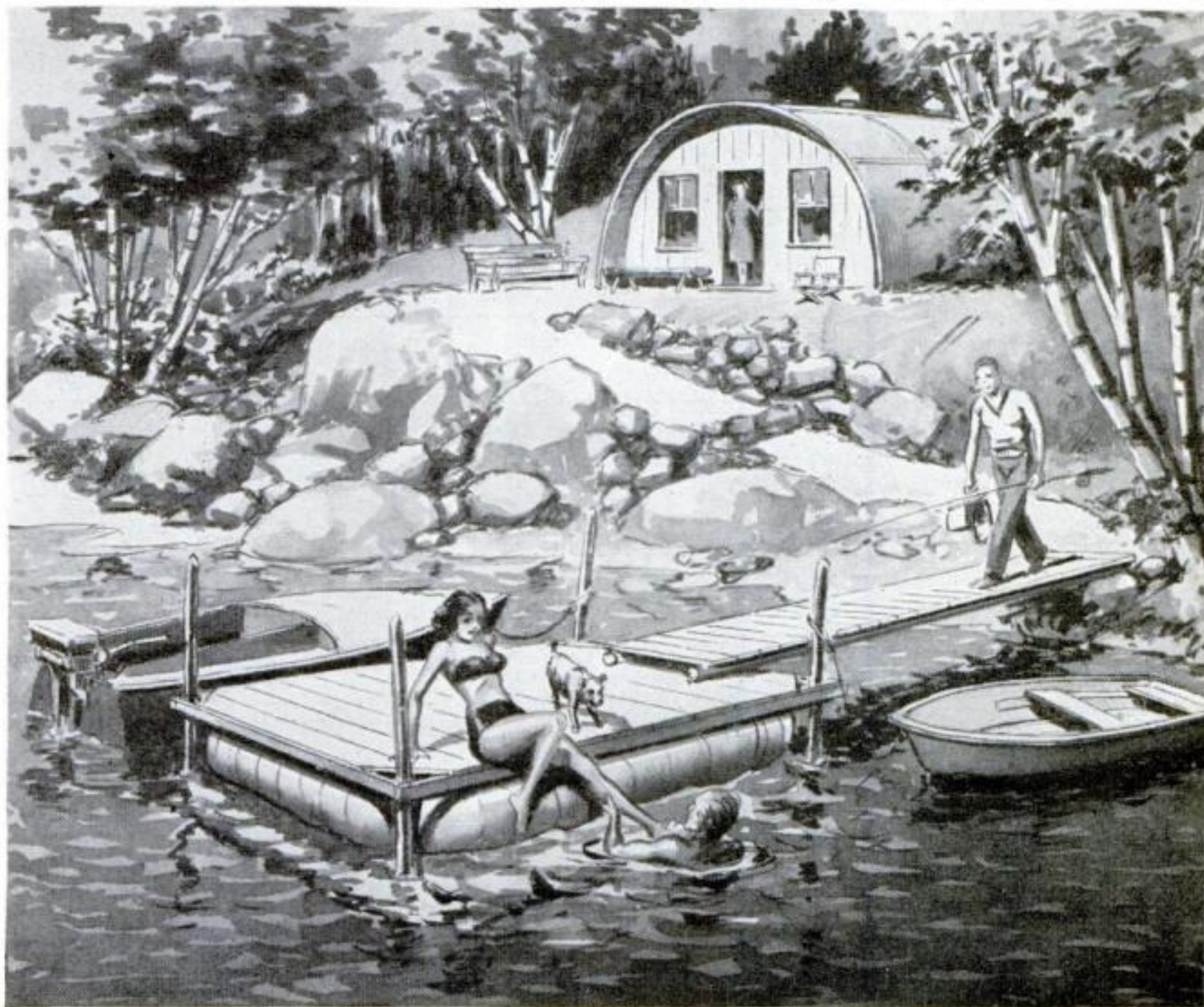
Practically all excess Army clothing—boots, trousers, socks, shirts, mitts, parkas—will fit into the needs of farmers and outdoorsmen. So will much of the smaller equipment. Collapsible rubber rafts and boats, particularly in the smaller sizes, will be ideal for fishermen and vacationists, who are already clamoring for a chance to buy them. Jungle and survival kits are on the "must" lists of hunters and Boy Scouts.

Not many firearms are yet on the market, though they are in high demand—with the carbine topping the list just now. For those who wish to restock that or any other rifle, walnut gunstock blanks can already be bought in some places. They are priced around \$1 apiece, cheaper in quantity lots. Not all those now available, however, are first quality, and anyone wanting to buy had better choose with care. A good many of these surplus blanks are being turned on



**OUTDOORSMEN** will snap up Army clothing. Above is our artist's idea of the way the popular battle jacket may be adapted for use as a hunting coat by the addition of a removable game pocket.

**SUMMER CAMPS**, both public and private, will furnish a lively market for Quonset huts, tents, outboard motors, boats, life rafts (for swimming floats), cooking and refrigerating equipment, and bedding.





down into dummy guns for use by school drill corps and similar organizations.

Among the bigger items, Quonset huts have a strong appeal. Some want them for vacation cabins, while others would use them for chicken houses, small cow barns, tool houses, workshops, and garages. Trailers are in demand—every type from light ones to be used as itinerant homes to the heavy giants now fitted out as mobile repair shops. And jeeps, of course, are still at the very top of the list, both among men still in the service and among civilians.

Jeeps, in fact, were listed in one out of every three entries in the contest for the best letters on "How I'll Use Surplus War Goods," announced in the March 1945 issue of *POPULAR SCIENCE*. Next in demand among the hundreds of entrants were rubber rafts, listed by 11 percent. Then came airplanes, particularly lightplanes; radios, including walkie-talkies; assault boats, power tools, hand tools, tents, firearms, trailers, electrical equipment. Other items on the list included flame throwers to be used as weed burners, smoke generators for orchard smudge pots, hand grenades to clear brushy ground, and a B-29 fuselage to be made into a roadside diner.



**THE CARBINE** is the most sought-after of Army firearms. Every hunter seems to have his own plan for converting it into the perfect sporting rifle.



**FIELD TELEPHONES** and radios have a high rating on the "must" lists. Phones will save farmers many steps; engineers and ranchers want walkie-talkies.

First prize-winner Pvt. Arthur P. Ives, of Fort Benning, Ga., plans to set up a small airport and equip it with jeeps, trailers, telephones, radios, and small planes, all from war surplus. Second prize-winner C. A. Wold, of Togo, Minn., hopes to convert his farm into a rest camp for returning veterans and wants sports equipment, jeeps, rubber boats, tents, insecticides, maybe a small airplane. Electrician's Mate C. M. Newman, of Camp Shoemaker, Calif., third prize-winner, expects to buy one of the Navy's 50-foot liberty launches and convert it into a coastwise cargo vessel to serve



**SMOKE GENERATORS**, such as the big M-1, may find peacetime employment in replacing the orchard smudge pots for saving citrus fruits from frost.

**THE JEEP** figured in one third of the letters received in the Popular Science contest. Proposed uses covered nearly every field of human activity. Farmers will probably be the largest single market.





British Columbia and southern Alaska fishing villages.

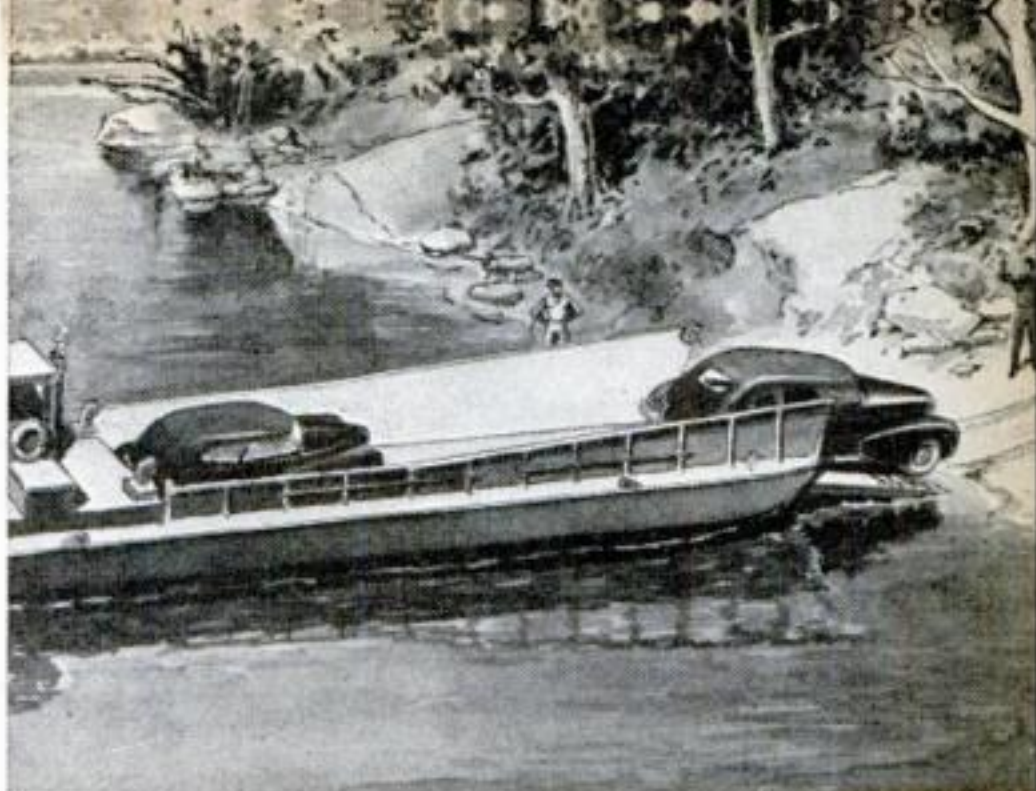
Lasalle L. Nolin, of Woonsocket, R. I., would equip an amphibious jeep as a lifeboat and first-aid vehicle for use on rivers and lakes; Howard L. Smith, of Brockton, Mont., wants an amphibious jeep to haul grain from his ranch to market when the restless Missouri puts the ferries out of commission.

Shortage of household equipment is reflected in the number of people who want to buy electric power plants, heating equipment, laundry units, sewing machines, plumbing, and even secondhand lumber. Refrigeration units are also in demand, and air-conditioning units. Most of the air-conditioning, heating, refrigerating, and power units are of a size not suitable for private use. So, too, with much of the furniture, kitchen equipment, and laundry units. These belong in large camps or hotels and restaurants.

And for those who think hopefully of getting used planes at bargain prices, a clear warning should be given that most of the planes will have seen hard service and will, at best, be expensive to recondition and to fly. They are warplanes, built for maximum performance, not economy. Prospective purchasers should be wary and well advised, particularly about CAA licensing and inspection requirements. For that matter, most of the surplus jeeps will have taken a beating and will be in considerably less than first-class condition. That goes as well for trucks, tractors, and bulldozers.

But a great deal of the other material is in good shape. Hardware and hand tools, for instance, will find a ready market. There's also a good deal of lumbering equipment, ranging from chain saws to axes, cant hooks, and wedges. The chain saws have a strong appeal to farmers and owners of small wood lots who lay by a few cords of firewood every fall. Some of the men in the service who have used those saws plan to get an Army truck, a chain saw, a few good axes, and a partner and set themselves up in the firewood business.

A good many of the service men look forward to having their own small business, based on skills they have learned or expanded during the war and outfitted with surplus war material. Prize-winner T/4 Paul R. Leonard, of Brooklyn, N. Y., expects to equip a trailer with machine tools and follow the outboard-motorboat racing enthusiasts from meet to meet, servicing their boats and motors. Several airborne engineers plan to use the lightweight airborne equipment—the versatile compressor units stand in particular favor with them—to do power jobs *(Continued on page 270)*



**LANDING CRAFT** will make excellent ferries on the northern lakes, according to W. E. Kissler, of Ardmore, Pa. C. M. Newman, of California, would buy a Navy liberty launch for cargo service along the Alaskan coast.

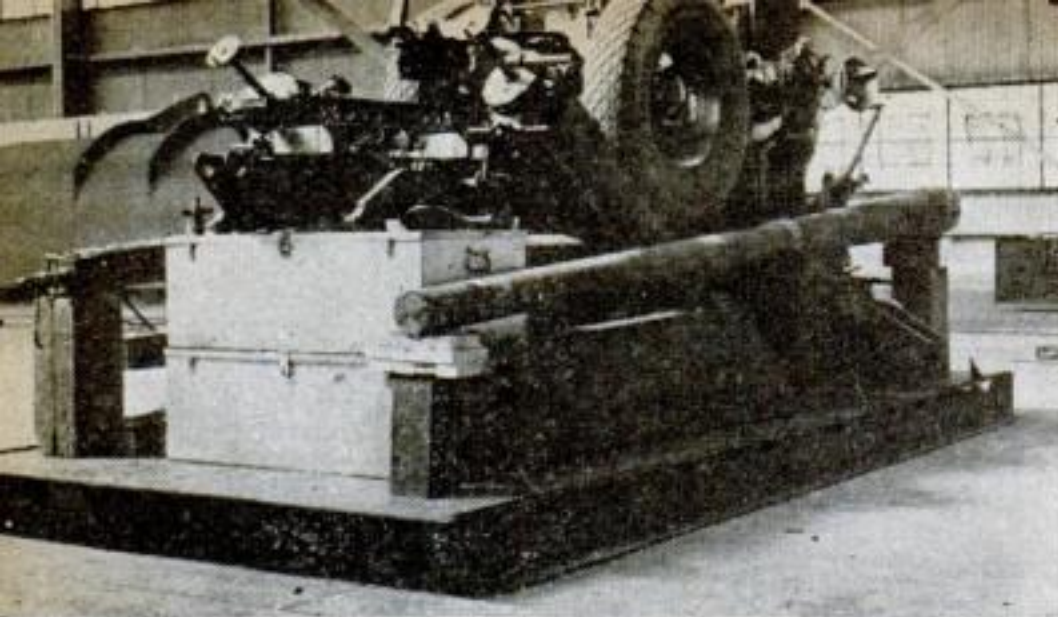


**SEAGOING JEEPS** are picked for the job of hauling grain to market over flood-covered roads. Another reader would equip the amphibious quarter-ton for life-saving and first-aid work near lake and river resorts.

**MIDGET BULLDOZERS** and other lightweight equipment built for airborne engineers would be ideal for excavating, grading, plowing, and other small-scale construction jobs, says George B. Robart, Portland, Ore.

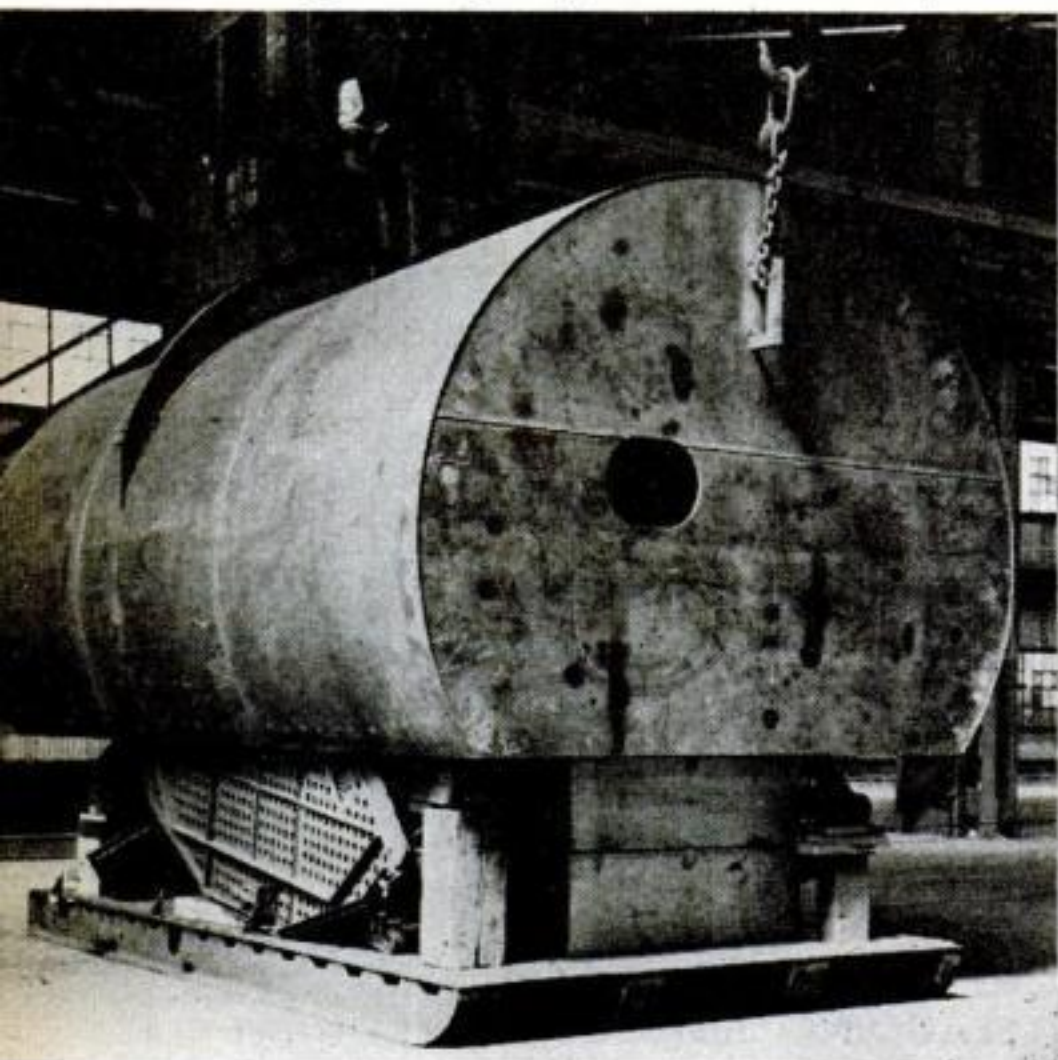




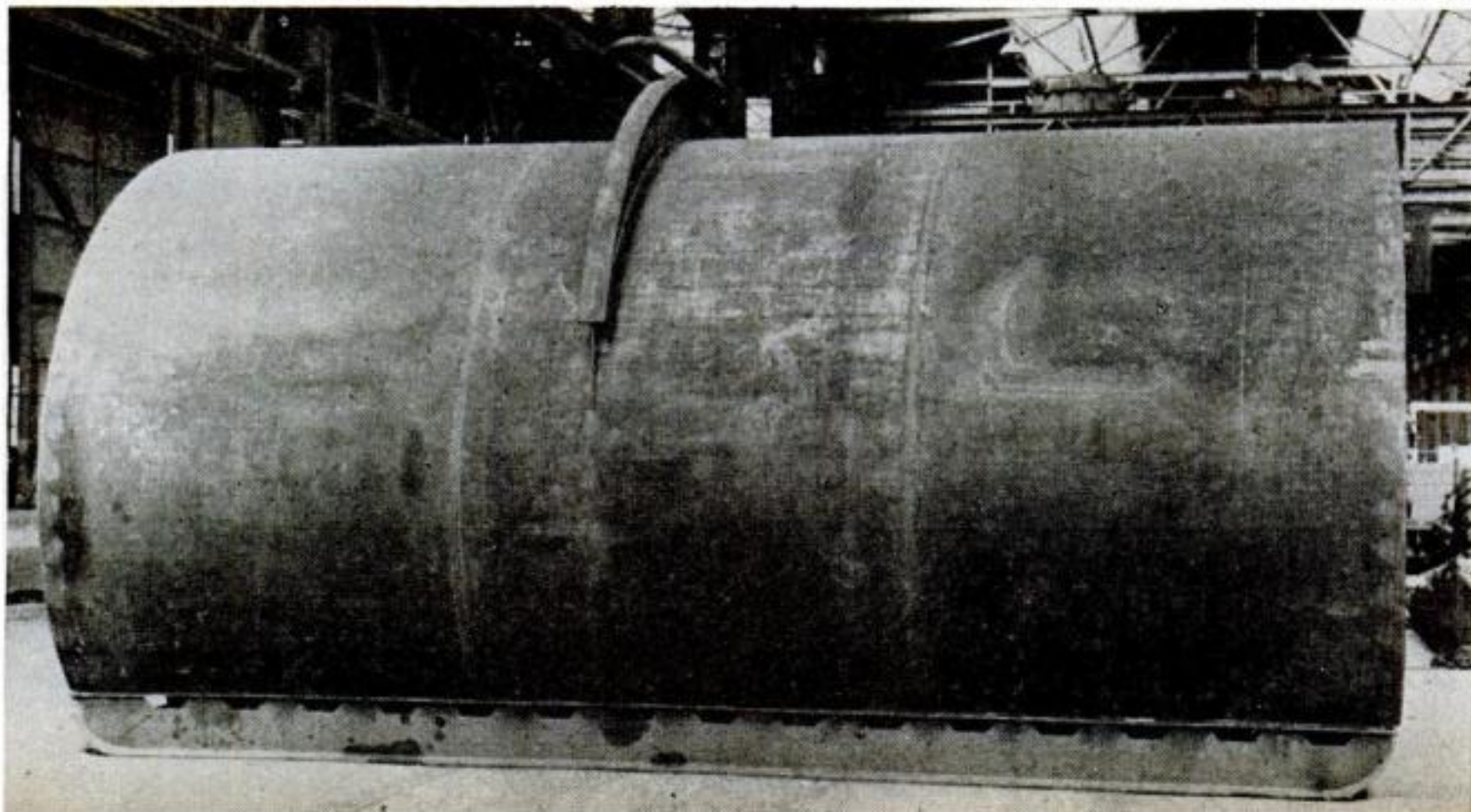


This is a 90-mm. AA gun, dismantled and ready for the jacket that will protect it against corrosion.

Steel "can" is let down to envelop the gun. Timber blocking is temporary; metal brackets replace it.



With its container hermetically sealed, the weapon can be stored outdoors anywhere. Field crews can reassemble gun in a few hours. If desirable, guns can be "canned" in firing position, ready for quick use.



## IT'S "CANNING" TIME FOR GUNS

THE Army Ordnance Department is perfecting two methods to preserve the almost 750,000 artillery pieces it possessed when the war ended. In cold storage, the guns will require no inspection or overhaul.

One plan is to put weapons into sheet-steel containers  $\frac{3}{16}$  to  $\frac{3}{8}$  of an inch thick, according to the size of the gun. The air in the container is replaced by an inert gas, such as nitrogen, and the "can" is hermetically sealed with dehydrating silica gel. No matter how long the weapon is left in the container, it will not corrode or suffer other damage. Various finishes to protect the "can" itself against corrosion are now being worked out.

The other method puts a weapon and a number of packages of silica gel into a container made of 16-gauge aluminum. This "can" is not airtight, and, during the day, heat from the sun expands the air inside, some of which escapes through a "breather" pipe also holding silica gel. When lower night temperatures contract the air inside the can, outside cool air dried by the breather's silica gel is drawn inside.





Salvator Salvatori had a postwar plan: to run his own business, refinishing antiques. How he swung it makes the first story in a series on ex-GI's who win peacetime victories.



Here is Salvatori in his shop, where he reclaims and transforms broken-down antiques for high-grade interior decoration. The price he'll get for the cherub he's holding won't be hay.

## His Mustering-Out Pay Was His Capital

**A**T 1014 Second Avenue, New York, there is a small store, with a smart, stylized-antique coffee table in the window. Inside, among cluttered tables, screens, lamps, and similar decorators' pieces, you will find the shop's proprietor, a stocky, handsome young fellow named Salvator Salvatori.

At first glance the place looks like any other antique furniture and restorer's shop in the neighborhood, except that it is smaller. And the proprietor seems remarkable only for his youth; he is, as a matter of fact, barely 21.

But first glances are deceptive. Salvator Salvatori, former Radioman USN, has made quite a stir around New York on two counts: first, he's one former fighting man

who has shown that he can start his own business from scratch and make a go of it. Second, he has provided interior decorators and their well-heeled Social Register clients with something smart and new with his pickled-gold lamps and smoked-mirror screens.

As the successful discharged service man, Salvator has become a kind of symbol of the million and a quarter service men who expect to go into business for themselves. The GI Bill of Rights offers them certain but definitely limited assistance. And wise-aces cite the fact that most one-man businesses fail before they get started. What's the answer? People, including the GI's themselves, watch ventures like Salvator's





Pedestals are sawed from wood floor lamps, divided in half with a vertical cut, and refinished. Then, turned upside down, they are used as wall brackets for holding vases, statuary, or other ornamental objects of art.



to find out. So let's take a look at Salvator Salvatori and see what has made his enterprise click.

First off, get this: Salvator is a symbol, but he's not typical. He's in a nontypical field of business. But the basic principles he has followed can be followed by the typical man in the typical man's field—and can lead to success. All right:

Salvator Salvatori, Radioman USN, was injured in an accident in the Pacific area after some two years of active service. So he was honorably discharged, with enough disability pay to keep him eating, and \$300 mustering-out pay.

He had, then, this limited capital (which most GI's figure will just about buy their civilian clothes and incidentals) and a determination to start on his way. This wasn't just a vague notion that he wanted to be his own boss. And it certainly wasn't a delusion that he would be able to take it easy. He knew that the man who starts on his own must work longer and harder than the fellow who just takes a job.

He had no trade. As a kid, he had helped around his father's shop. (The elder Salvatori makes fine lamp shades and sells them to people who spend considerable money on the interiors of their homes.) As a helper, he had picked up only minor skills with paintbrush, sandpaper, gold leaf and glue. In the Navy he had learned how to use simple tools accurately and neatly. So though he was an instinctively good crafts-

man, he had less craft skill than many a home-workshop addict.

He had, however, been brought up in an atmosphere of good workmanship and good taste. Without any formal schooling in design, he had soaked up a feeling for what was good in interior furnishing, partly in his father's shop, partly by familiarity with scores of New York antique shops, and very much by going as a delivery boy to the establishments of interior decorators and the homes of fashionable people.

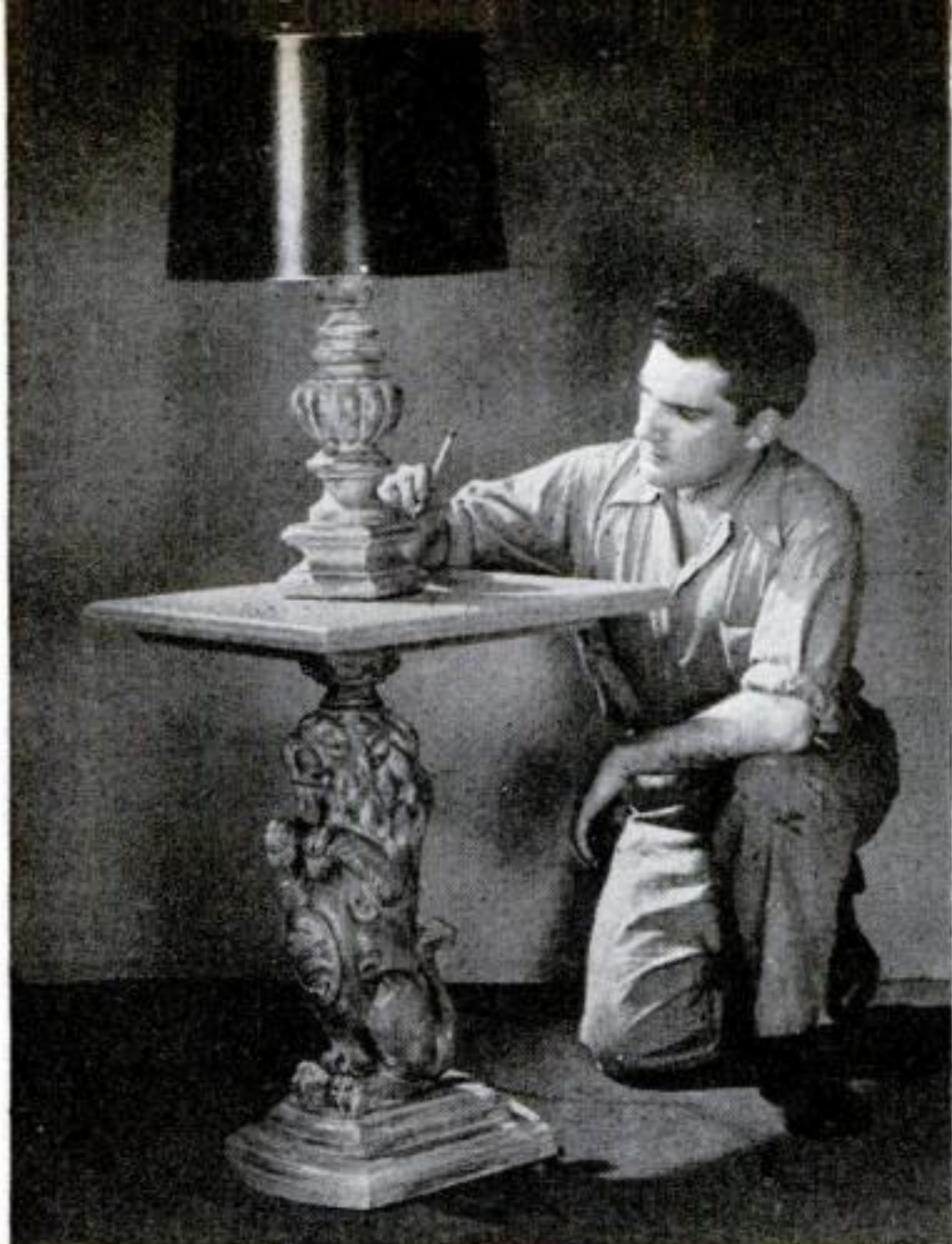
As a by-product, he had learned what people want and will buy for real money. And that is important, whether you're going to sell cheroots in cardboard boxes for two cents each, or cherubs in carved shadow boxes for \$200 a pair.

He had a pretty good knowledge of the antique trade in New York—of where, for instance, you could buy broken-down antiques at far below the prices perfect stuff commands. This added another basic requirement to his equipment: knowing the source of supply.

He had a clear head, with above-average ability to think for himself and think straight. Also he had an ingenious cast of mind, as you shall see.

Beyond these he had nothing. Capital? The GI Bill of Rights does not itself lend money to GI's; it only encourages banks to do so by offering to guarantee one half the amount of any loan a bank is willing to make for certain purposes, and up to a





Salvatori measures a leg from a big old library table. He has something on his mind. The picture at left shows what the idea worked out to. He added a new base and, above the lion's head, a section cut from a newel post. The lamp base on the table top was a newel post in a fine old house.

certain amount. The bank has to be satisfied with a man's security for its half of the loan. That ruled out Salvator, who had no collateral to offer, as it will rule out the great majority of would-be GI borrowers.

He had only \$300, a limited, highly specialized knowledge of a certain kind of business, and an idea.

He rented a store in the right part of town: not the swankiest or most expensive, but the part where the swanky people come to find high-priced bargains. He put money on the barrel head for a good location. He fixed up the place himself—with a little paint, a good rug, and a lot of hard work. In front was his showroom; in back, his workshop.

Then he went out and picked up some broken antiques: floor lamps, carved tables, cornices, mirror frames, newel posts—anything that had good design and good workmanship in the parts that were still intact.

Before carting this stuff to his shop, he took it apart and threw away the smashed parts. Then he studied the good parts remaining and put them together into new combinations that were striking, original, sound—and easily salable.

For example, he took the carved base of an elaborate floor lamp, sawed it in half lengthwise, refinished the halves, turned them upside down—and had a pair of wall brackets that an interior decorator went crazy about, to the tune of a wad of folding money.

He took two of three carved table legs (the other one was smashed), combined them with bases from some other pieces, and, with new electrical fittings and shades, made a pair of table lamps that are now gracing one of the most distinguished apartments in New York.

He got hold of a once-fine screen that was all shot, stripped off its shabby fabric panels, replaced them with mirror glass, smoked the glass, added some skillfully painted Cupid motifs in the authentic Empire manner, finished the whole thing in pickled gold—and came out with a piece that has been photographed for the top-ranking magazines by one of America's great camera artists.

Out of the cabinet doors of a ruined sideboard he made shadow boxes which, when furnished with small plaster busts, sold for big money. From flower stands and old mirrors he contrived coffee tables that stopped the passing "carriage trade." Carved gargoyles from a staircase became the legs of a pair of end tables that had one social registerite sending in her sisters and her cousins and her aunts to demand more of the same.

In all that sort of thing Salvator Salvatori is an artist—not merely a craftsman. It would be foolish to assume that his success could be duplicated by just anybody. His material costs little, but his product brings in big money because it is the product of brains and taste.



# Flyers Dug Way to Freedom



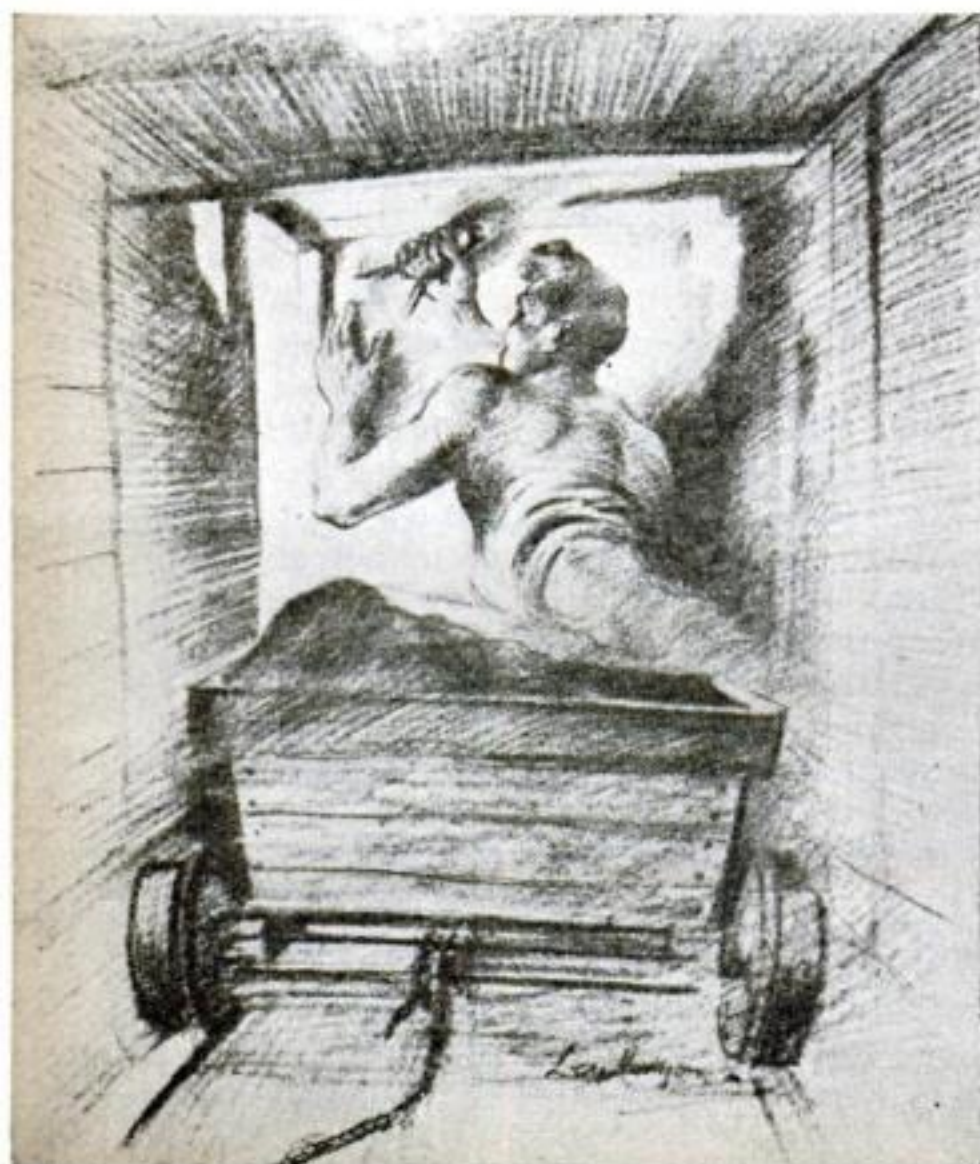
In this workshop beneath Stalag Luft III, RAF men did all the wood and metal work needed for the escape tunnel. The hanging can was a signal.

IT WAS only after 15 months of hard, continuous, and always dangerous work that a group of Royal Air Force officers succeeded in digging a tunnel more than 350 feet long beneath the buildings and barbed wire of Stalag Luft III, German prison camp for Allied flyers, to escape into a wood outside on the night of March 24, 1944. Although 50 of the Britons were recaptured and shot, the escape ranks as the largest mass prison break of the war.

Details of the audacious undertaking, which first appeared in *The Illustrated London News*, are revealed in these drawings made by Flight Lieut. Ley Kenyon, D.F.C., while work on the passage was under way. The sketches were found in a sealed case in a flooded chamber of the underground workings when Russian troops overran the prison camp.

The task was begun at Christmas 1942 with the sinking of a 30-foot-deep vertical shaft beneath a stove in the corner of one of the camp huts. This shaft led to a workshop where specialists made tools, devised "machinery," mortised together wooden bed boards as linings for the shafts and the tunnel itself, and manufactured all necessary equipment. One example of their ingenuity was an air-conditioning plant, shown on the opposite page. They also made and laid rails and made trucks for carrying men and excavated sand away from the working area—under close Nazi guard.

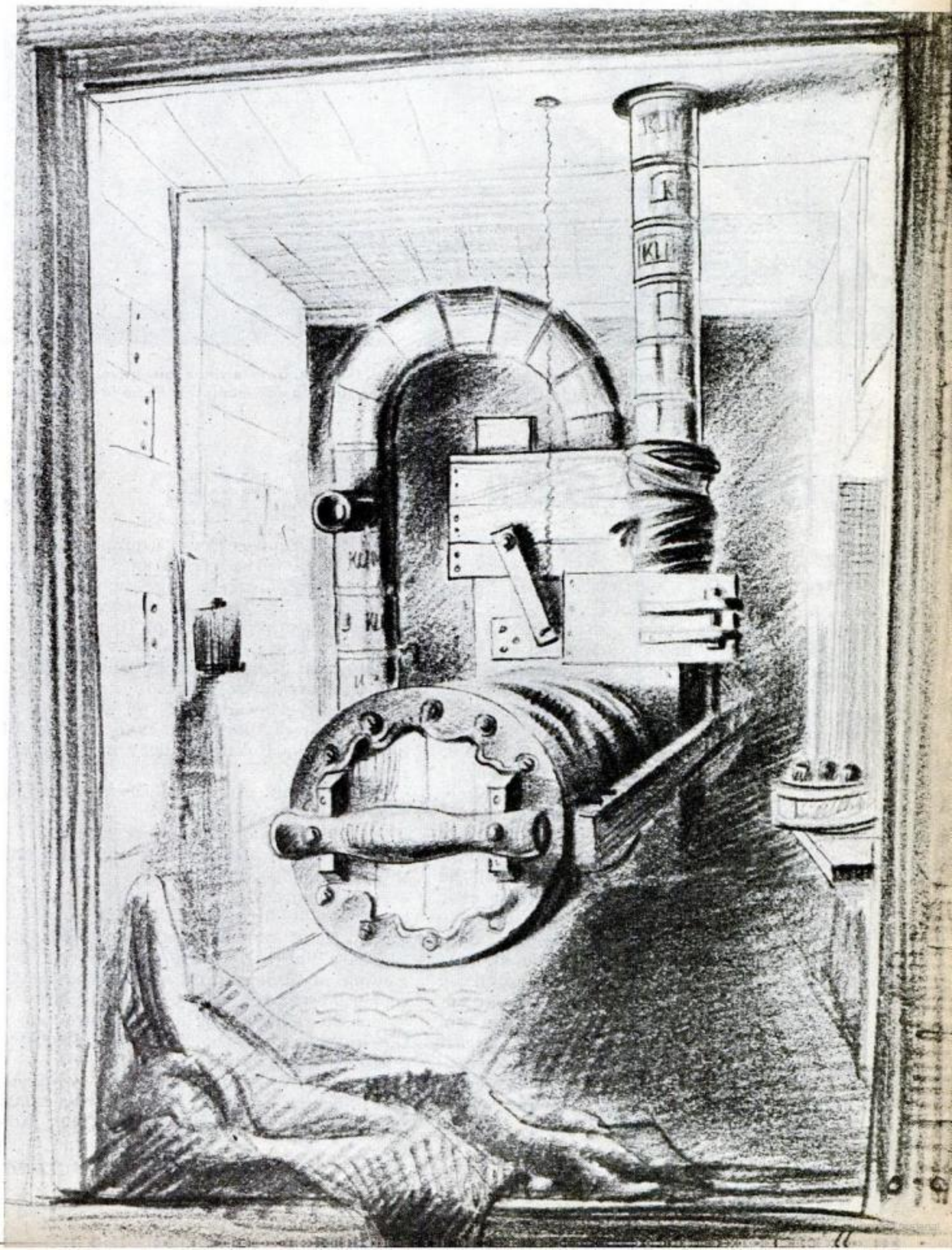
Digging away in the three-foot-square tunnel (left, below) where only one man could operate at a time. At the right, a box of sand is hauled back to tunnel mouth, as operator of air-conditioning pump looks on.



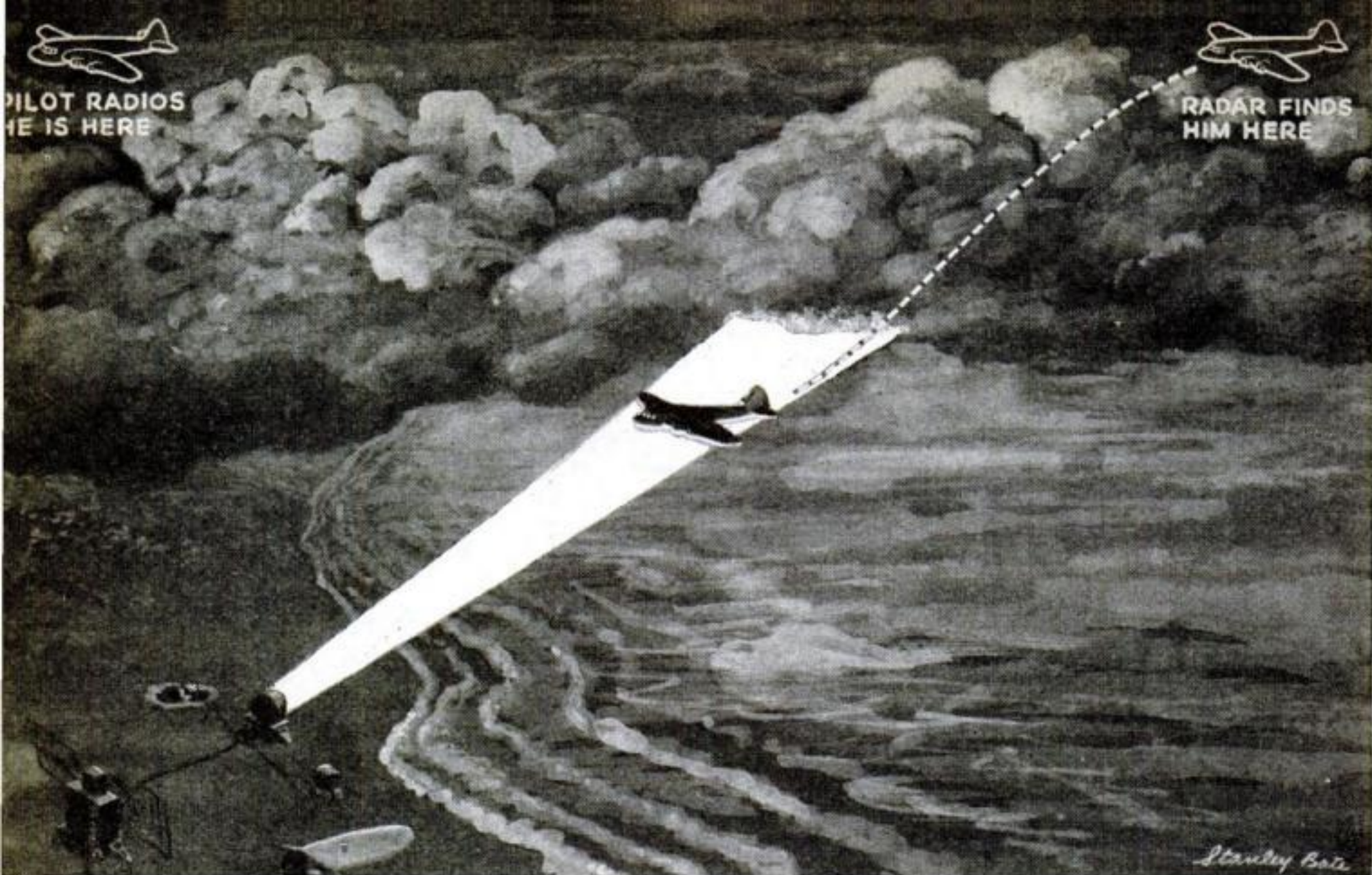


# in Greatest War Prison Break

Here's the air-conditioning plant the Britons made not far beneath the feet of their Nazi guards. The main air tubes consisted of dried-milk cans fitted together, but they sent fresh air through the 350-foot-long tunnel. Pressure was supplied by the crude bellows in the foreground, operated by handpower.







Its war role well done, foolproof radar will now eliminate the risk from civilian air travel. Controllers at ground radar sets at airports and along the coast will unerringly guide transports home in any weather.

## HOW RADAR WILL HELP YOU

By HARRY M. DAVIS

THE man-made eyes that secretly aimed guns and bombs until V-J Day first proved their peacetime usefulness seven years ago by leading a lost flyer safely back to land—and that's the way radar may soon serve you. It will give the air lines the equivalent of the railroads' signal lights, semaphores, and automatic block systems.

On a cloudy, windy night in December 1938, less than a year before World War II began, a convoy of trucks and strangely rigged trailers was hooked up to an Army searchlight in a carefully guarded area near the mouth of Chesapeake Bay. The equipment was the first service test model of the Signal Corps Laboratories' "Detector Against Aircraft, Radio." From Langley Field, Virginia, an Army bomber flew toward the test zone. The pilot's instructions were to approach from any angle on the landward side. The job of the radar operators was to find him, track him, light him up with a searchlight so that antiaircraft guns could theoretically shoot him down.

In this crucial test, which was to decide whether listening-horn sound locators were to become obsolete, the new radio detector

apparently failed. For 45 minutes the antennas were turned from side to side and tilted up and down—yet the anxious watchers of the scope could see no signal. High-ranking observers, some of them skeptical about this new gadget that was supposed to see through clouds, were getting impatient. The engineers were worried.

Then Dr. Harold Zahl, physicist of the Signal Corps Laboratories, had an idea. He turned to the Coast Artillery liaison officer and asked:

"How about searching toward the sea. The wind up there—"

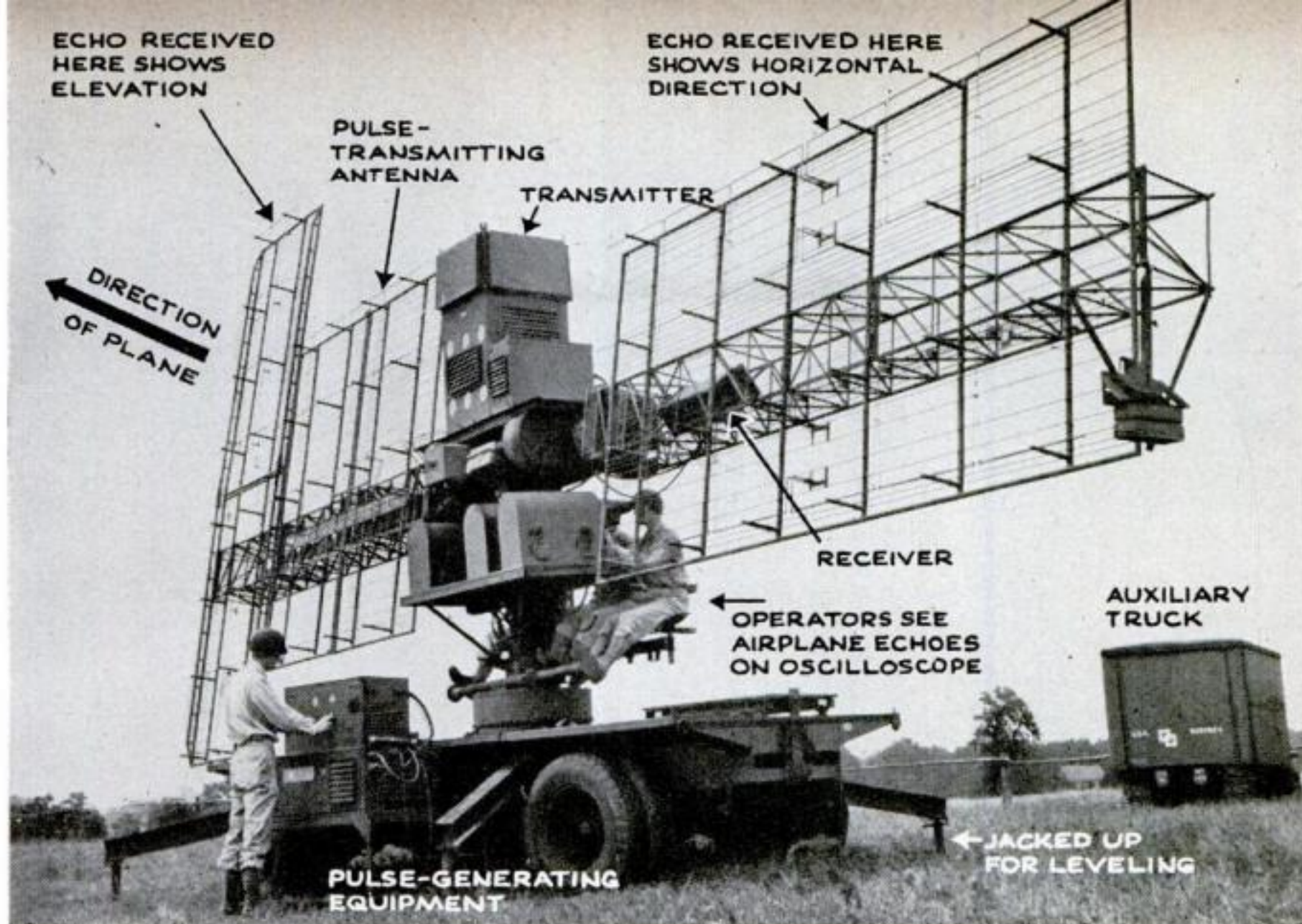
"O.K.," he said. "Turn her around."

The operator cranked his handwheel until the antenna faced east.

Almost immediately a "pip" showed on the scope—a little inverted "V" formed as the trace of the electron beam rose from the base line to indicate that an echo was coming in. Its position at the edge of the scope showed that the echo came from an object 23 miles away, and the direction of the antennas showed that the object was out over the Atlantic.

Meanwhile, the pilot had been telling the test officials by radio that he was 20,000 feet above Fort Monroe, Va. The radar





Here is radar in action. Installations like this one pin-pointed enemy planes through miles of overcast. Now, radar stations set up along commercial air-line routes will constantly tell planes where they are.

operators radioed the pilot to circle around. As he did, the echo on the scope bobbed up and down. The operators then told the pilot to drop below the clouds for a look. He found nothing but a vast expanse of cold, gray water. From then on the pilot took his instructions from the radar operators. They navigated him back to shore by radio, telling him all the time just where he was.

That was the first known occasion in America when radar served for air navigation. Throughout the war, one of radar's main contributions was in telling airplanes where they were and when to bomb.

This story illustrates one way by which radar will help eliminate the risk from civilian air travel. Controllers at ground radar sets at airports and other key locations along the airways will tell at a glance the direction, altitude, and distance of all aircraft within their zone of coverage. This is likely to be the first application of radar to air travel, since ground sets of this type are in production and a number may be disposed of as surplus by the armed services. An immediate advantage of this kind of flight control is that a comparatively small number of stations on the ground can cover an entire airway, and no special equipment in the airplane is required.

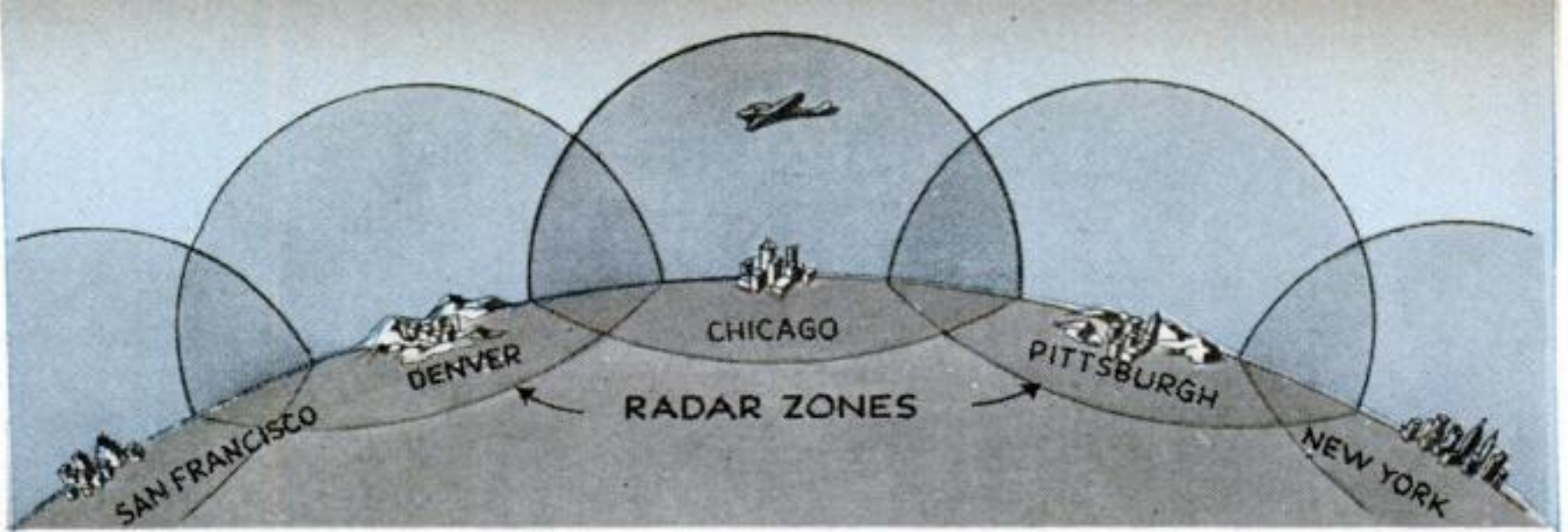
There are many other ways in which radar will help. They depend on its two

great virtues—measuring the exact distance of a remote object and determining the object's direction. In many applications, both features are used. In other applications, the measurement of distance alone is sufficient, since if the distance to two or more known objects is determined accurately, the position of the airplane can always be picked out on a chart by triangulation. Radar measures distance by timing the period between the sending of a pulse and the reception of its echo—and does this with great precision.

To appreciate just what radar can do for air travel in the near future we must realize its limitations as well as its dramatic capabilities. Radar is not television, although the two have many things in common. In television you need good enough visibility at the sending end to impress a picture on the iconoscope. The whole moving picture is transmitted as it happens by radio, but it only makes a one-way trip.

In radar, on the other hand, a round trip is always involved. You send out a brief pulse of radio waves; if they hit a solid object, a faint echo comes back. Television transmits what the eye can see. Radar records things the eye cannot see. Radar does things that television cannot do—it sees through fog, smoke, clouds, and darkness. Television does things that radar cannot do—it gives you the actual details





A comparatively small number of radar ground stations will cover an entire airway. Each one, when it receives an interrogating pulse from a high-flying plane, will respond with an identifying set of signals.

of the picture, whereas radar only gets an indication that must be interpreted before it can be used.

Radar has contributed greatly to the perfection of television through the development of components used in both. For instance, the favorite indicator in radar is the scope—the cathode-ray oscilloscope—which is very similar to the viewing screen of a television receiver. Scopes have been tremendously improved as the result of radar's needs, and the consequence will be clearer television pictures.

Again, the receiver which amplifies the faint echo of radar must be of "video" quality, that is, it must build up the pulse

to a usable strength without distorting its shape. Television engineers struggled for years with "video" amplifiers that would present a true picture to human vision. Radar engineers borrowed that technique and perfected it. Thus the \$2,700,000,000 United States investment in radar will be reflected to the public in better television.

The investment in radar will also safeguard our airways. But we might as well be realistic about it. The superlative military precision instruments that weigh hundreds of pounds and cost from \$10,000 up aren't going to be issued as accessories with every flivver plane. There will have to be a lot of adapting, simplifying, and cheapening. Fortunately, for purposes of safe navigation in a peacetime world, many of the costly complications of military radar aren't needed at all.

There has been a lot of discussion of the "Mickey" radar used by bombing planes to search the sea for ships and submarines and to pick out such ground targets as cities. With "Mickey" the pilot can see on the scope a maplike presentation of rivers, coastlines, and built-up areas. This kind of radar was used in the night and bad-weather bombing of Germany and Japan. However, even with all the funds and priorities given to radar by the Army and Navy, it was never possible during the war to equip all bombing planes with "Mickey." For a long time the practice was to have only one plane in a squadron so equipped, serving as a "pathfinder," and it dropped the first bombs or smoke indicators. The other planes then dropped their bombs in the area designated by smoke, fire, flares, or explosions. Eventually, this "Mickey" radar may be simplified and adapted for cheap mass production, but not now.

However, we can still have good radar navigation very soon. What does seem very probable in the near future is that commercial and private airplanes will be equipped with auxiliary radar equipment to work in conjunction with a system of powerful radar stations on the ground. This will be a contribution from the wartime



On ships, the "electronic navigator" will detect obstacles at distances up to 30 miles in any weather.



system known as "IFF"—identification, friend or foe. Originally designed to distinguish a friendly plane from an enemy on the radar scope, IFF has since developed into a navigation system using "racons"—radar beacons.

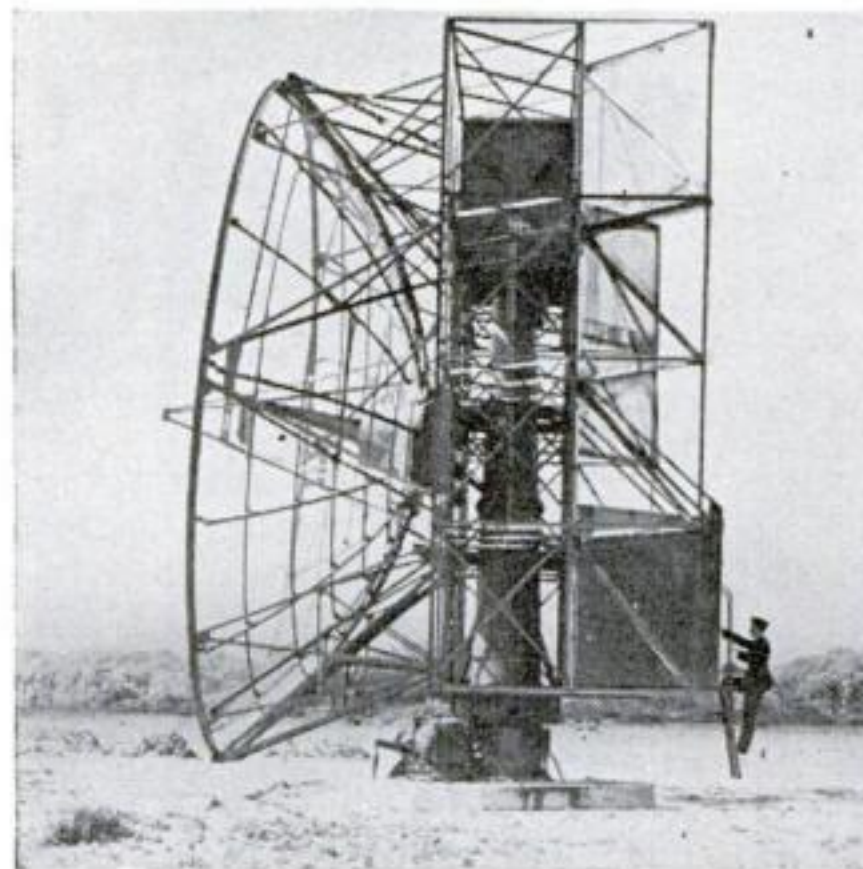
In this system a receiver is tuned to the wave length of a transmitter on the ground. It is hooked up to its own small transmitter, also on the airplane. The combination is known as a transponder—it transmits a response, acting like a radio relay except that it puts its own identifying stamp on the amplified response. But it does more than identify. When the airplane has a transponder, the range of the ground radar on friendly airplanes is greatly increased. Thus, in the world of peacetime commerce, in which all commercial planes will be friendly, it will not be necessary to equip an airplane with its own complete radar set. All that will be necessary will be a transponder. In this way the ground radar stations can keep check on airplanes over a large area and tell them where they are by radio.

When a transponder is mounted at a fixed position on the ground it is known as a racon (radar beacon). Here, instead of having a ground radar station send out a pulse to which the airplane responds, the system is reversed. At various points on the ground, transponders are set up. Each one, when it receives an interrogating pulse from an airplane, sends its answer in a particular combination of radio pulses. Each ground radar beacon has its own set of signals which identify it positively, just as every lighthouse along the coast and every lightship anchored in a shoal area has its own special color combination and sequence of blinking the lights on and off. In fact, it is quite reasonable that all lighthouses will eventually be equipped with automatic radar beacons to respond to interrogation from ships. This would make them operative in the worst fog, when present-day lighthouses lose their value.

The method of finding your position with radar beacons is a little different from the triangulation used by surveyors, although it is based on the same simple geometry. In ordinary triangulation you get two directional bearings from the point to be located, draw those directional lines on a map—and where they cross is where you are. In the radar-pulse method you get the distances from two known beacons and use each one as the radius for a circular arc that can be drawn on the map with a compass. Where the two circles intersect is where you are. The measurement of distance by even small portable radars is so accurate that (Continued on page 234)



The "Mickey" set (note the "ears") measures electronically the height of unseen planes in its area.

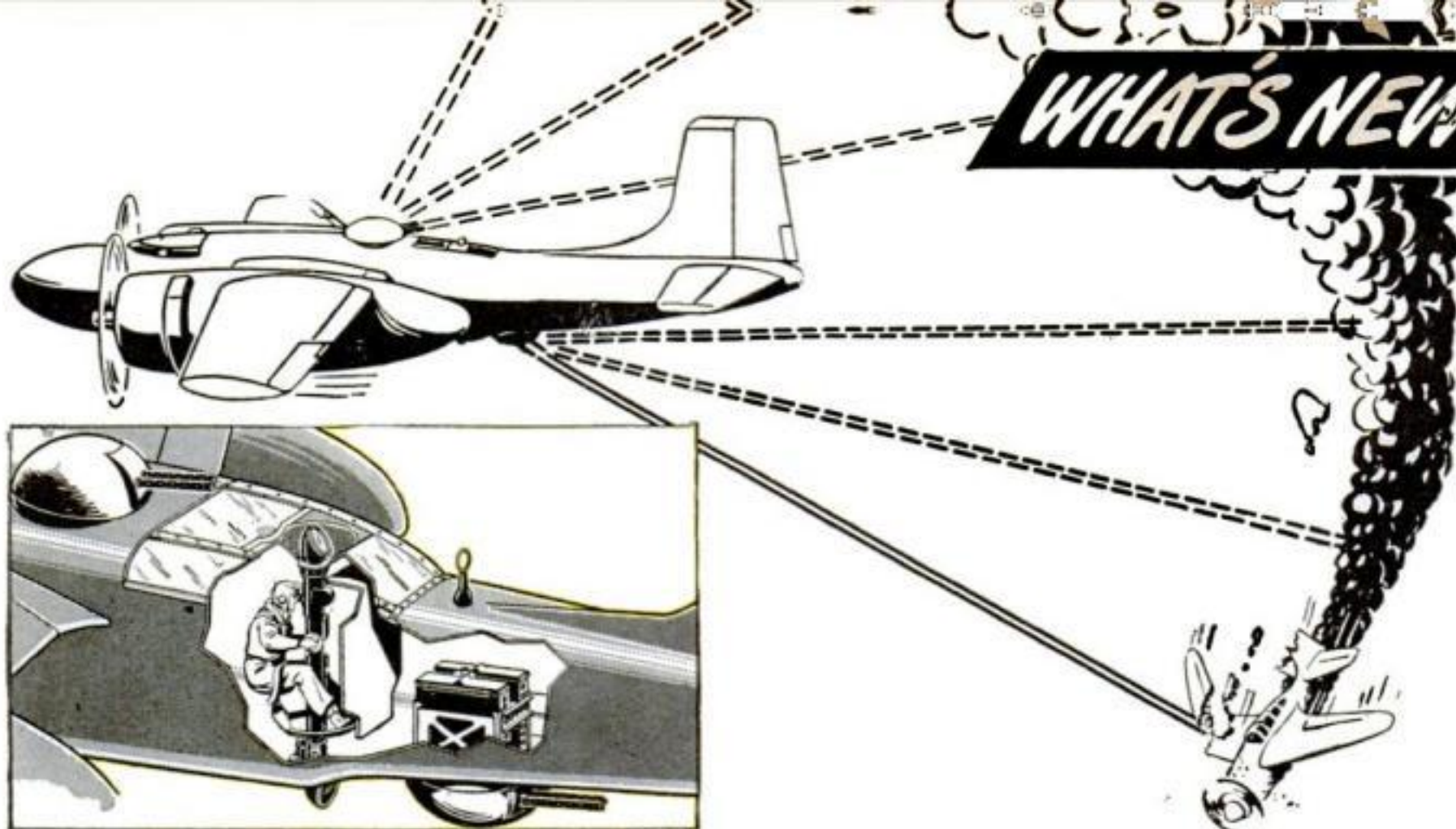


This radar saved Britain in dark days of 1940. It told range, direction, and altitude of Nazi planes.



England had complete radar coverage along her channel coast in 1938 with 15 of these 360-foot towers.





## TWO-WAY PERISCOPE GUN SIGHT DIRECTS A-26'S FIREPOWER

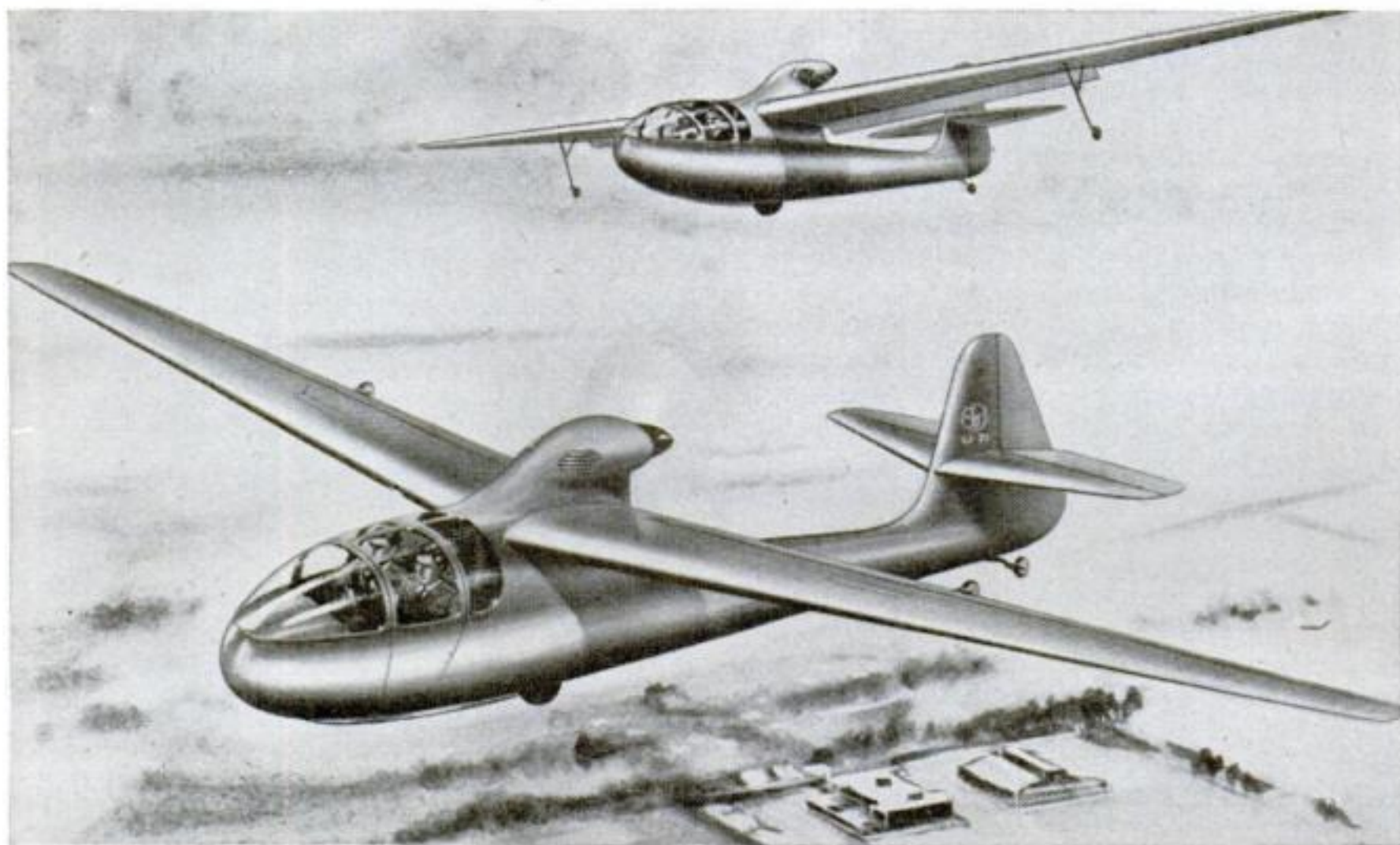
A TWO-ENDED periscope gun sight developed by General Electric helped make the Douglas A-26 Invader attack bomber a deadly weapon against both Germans and Japs. Passing entirely through the fuselage, the periscope enabled one gunner to scan the skies in almost any direction and

bring the fire of two twin-gunned turrets to bear on any attacker. Tracking the target through one of the sight heads, the gunner could switch over instantly to the other if the enemy plane dived or climbed into the other hemisphere, with the controlled turrets moving and firing with the sight.

## PUSHER-TYPE LIGHTPLANE DESIGNED ON GLIDER PRINCIPLES

ALMOST foolproof landing characteristics are claimed for the VJ-21 two-place private plane under development by Jarvis Manufacturing Co., Glendale, Calif. A single main landing wheel and steel nose skid make

it possible to land at 40 m.p.h. on a rough field. There are retractable wheels on the wings and a swivel tail wheel. The 65-hp. plane cruises at 110 m.p.h., and is expected to sell for less than \$2,000.







## BRITISH STRATOSPHERE FIGHTER HAS PRESSURIZED CABIN

DEVELOPED to meet the menace of high-flying raiders, Britain's Westland Welkin fighter can meet an enemy in the stratosphere with an armored, pressurized cabin

and four cannons. Largest British single-seater fighter, it has a wing span of 70 feet and is powered by two 1,650-hp. supercharged Rolls-Royce Merlin engines.

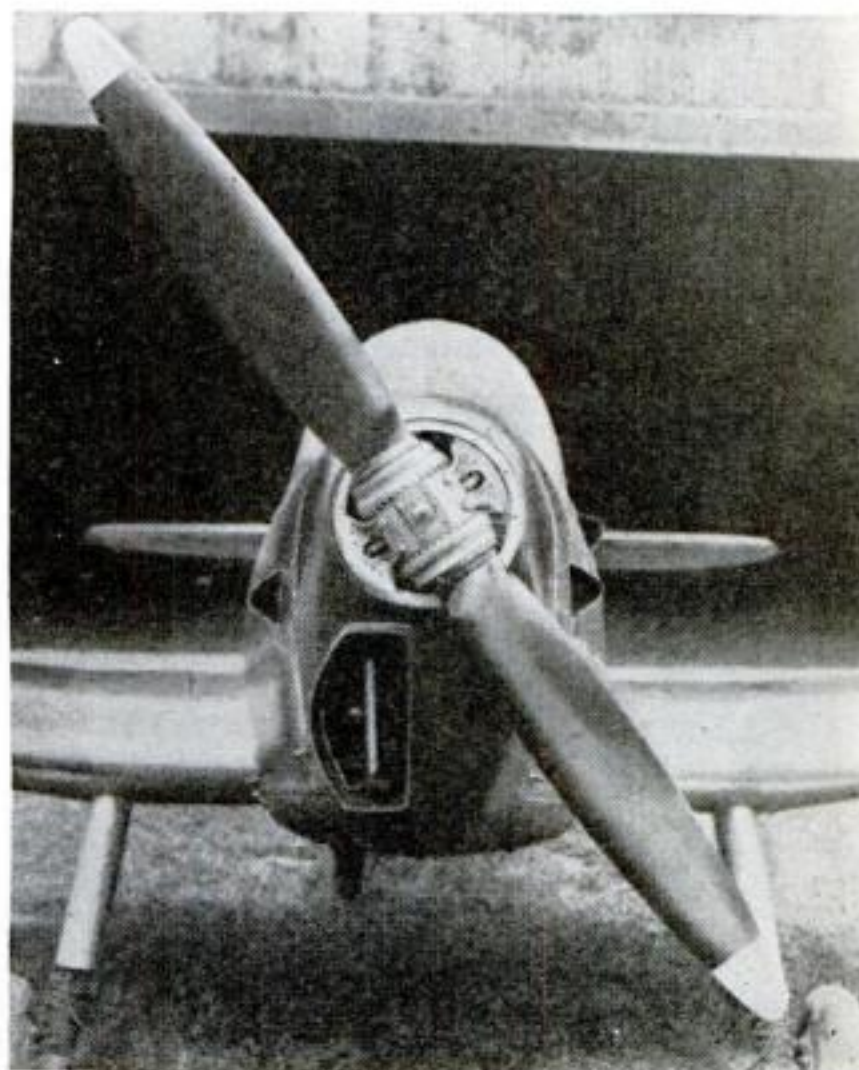


## MONSTER GERMAN TRANSPORT-BOMBER FLOWN TO U. S. FOR STUDY

ONE of the biggest land planes ever built in Germany landed at Patterson Field, Ohio, recently with a crew of 10 Yanks. The Junkers 290 is a four-engine, low-wing craft with a span of 138 feet. When used as a bomber, it could carry 10,000 pounds of bombs 2,000 miles. As a transport, it had room for 90 men.

## MANUALLY OPERATED VARIABLE-PITCH PROPELLER FOR SMALL PLANES

BRITISH owners of small planes of less than 200 horsepower can enjoy the advantages of the variable-pitch propeller in a simple mechanism developed by De Havilland. To change blade pitch, the pilot turns a small handle. Through a flexible shaft, this operates a worm gear in a box on the engine nose to set and lock the blades in any position desired.







Besides the fierce shark-face grin, this China-based P-51 went out after the Japs with a 250-pound bomb and a 75-gallon fuel tank under each wing. This combination of outboard equipment gave fairly long range and a good, strong dose of trouble for enemy ground installations.



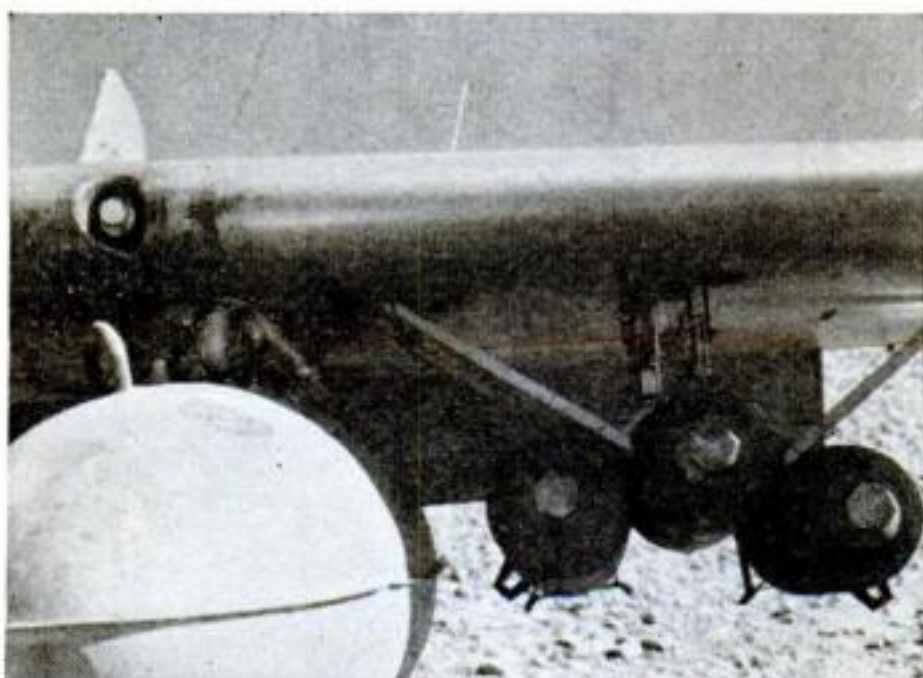
For medium-range work: three 100-pound demolition bombs and nine antipersonnel fragmentation bombs to a side. The sway braces are made of scrap wood.

With one droppable fuel tank and three 100-pound high-explosives under each wing, the fighter has a combat range of 1,378 miles for bombing and strafing.

## Under the Mustang's Wings

**W**HETHER it's a long-range fighter mission or a short-range bombing foray, the P-51 Mustang can adapt itself to the job. These photographs show outboard installations that were used by the Fourteenth Air Force in China. Wing racks were used to carry auxiliary fuel tanks and bombs of various types in any combination required by the nature of the target and the distance the plane had to fly to reach it. Fittings were improvised in the field.

Two tanks on each side make the Mustang one of world's longest-range fighters, with total fuel capacity of 569 gallons, range about 2,700 miles.







# COMPULSORY TRAINING IS VITAL

## Says MAJOR GEORGE FIELDING ELIOT

**T**HE proposal for universal military training for every American boy for a period of one year between the ages of 17 and 20 has attracted a great deal of support and a great deal of opposition. Frankly, this writer is a supporter; I have listened to many of the opposing arguments, and read all of them that were brought up before the House Committee on Postwar Military Policy—and for the most part the opponents don't know what they are talking about. I'm not trying to be sarcastic; I mean that quite literally.

Nothing could make the truth of my contention plainer than the sudden upsurge of half-baked outcries that the atomic bomb has made universal military service unnecessary, even obsolete. All the experience of this war and of the last shows that the more complex the machinery of war becomes, the more men it requires to handle, maintain, and transport it. Many people think of universal military training as being

nothing more than doing "by the right flank, march" on a drill field. Of course, that's nonsense. Military training means training men to do specific jobs in the military machine of the future, and then training these individuals to operate in teams to do team jobs efficiently and smoothly.

The development of new weapons changes the type of individual and team training, but it doesn't affect the fact that without trained individuals and trained teams, the new weapons will be quite useless. The atomic bomb, for example, in order to do its job, must be produced, must be transported to the place where it is to be launched, and must be projected against its target. The airplane which carries it must operate from a protected base, within operating radius of the target. It must be escorted or otherwise shielded against enemy attacks. Moreover, the atomic bomb is not the only weapon which is in course of development.

As for ground troops, they still will be

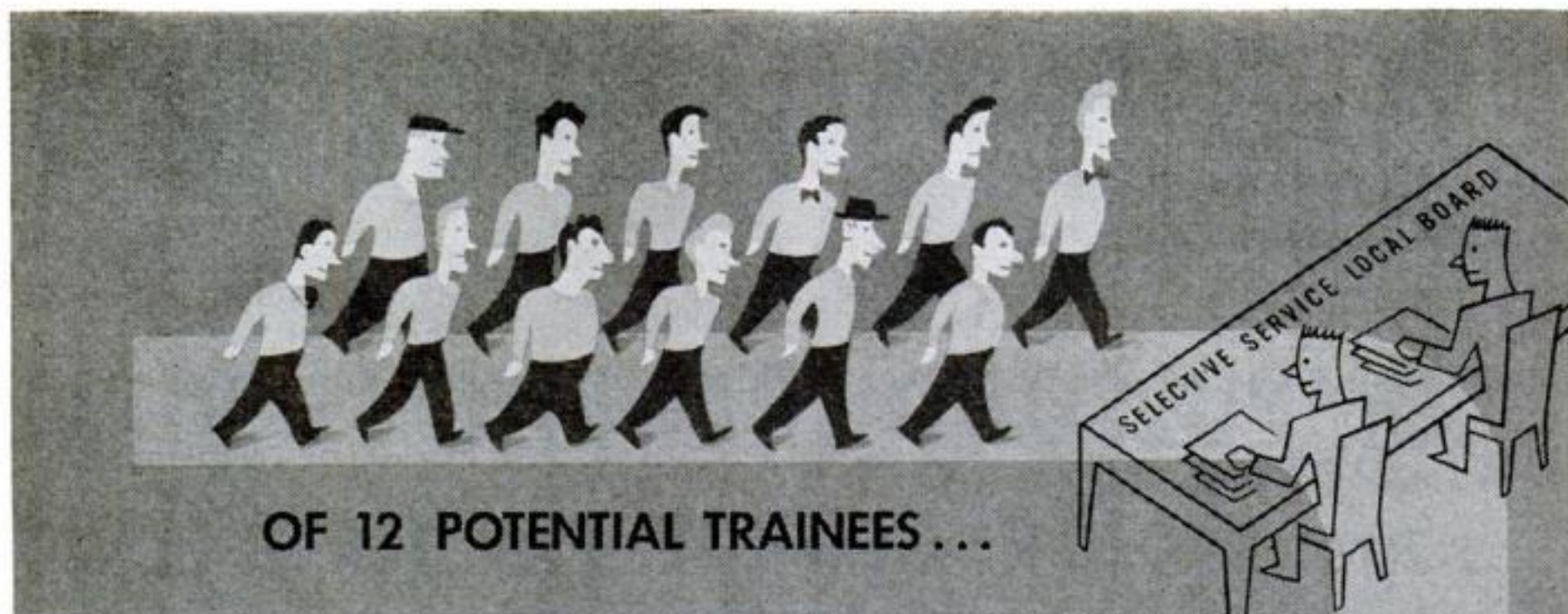


Today, "military training" means specialized training with the best equipment science can produce.



A year's thorough schooling in the Army will prepare a boy for a profitable job in civilian life.





Civilian boards would call up a fresh batch of trainees every three months. The fit would be channeled into roles best suited to them.

necessary, if territory is to be occupied, if the destructive effects of modern air attacks are to be followed up. Many ground troops may in the future be airborne; this will mean that a high proportion of the personnel will have to be devoted to transporting and supplying the actual infantry and artillery fighters, but it will not diminish the demands for manpower.

The push-button war involving just a few scientists on each side, immured in concrete-lined caverns, is a pure figment of the imagination. In fact, the more destructive the machinery of war, the more terrific in its short-term effects, the more necessary it is that we should have immediately available an ample reservoir of trained men to deal with any emergency. There may not be time to do our training after war has started, as there always has been before. The atomic bomb, the rocket, the guided missile have not lessened, they have tremendously increased the need for timely, adequate peacetime preparation.

Remember, all these weapons were known when the plans for the proposed military training system were drawn up.

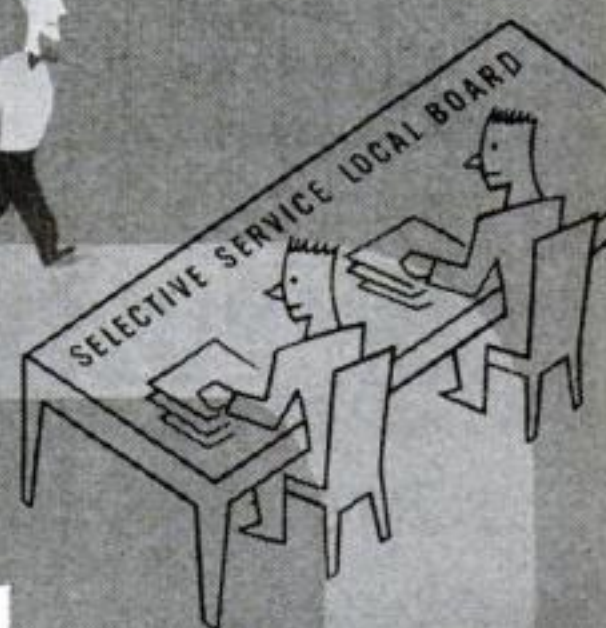
Going over the testimony of those opposing military training, we find several fundamental errors in it, besides the misconception about the atomic bomb. Here are some of them, and the answers:

(1) By enacting a military training bill now, we are showing a lack of faith in the United Nations Organization for the maintenance of international peace and security.

Answer: Nonsense. We are showing that we understand the United Nations Organization as being exactly what it is: an association of nations to keep the peace by force—the only way peace ever has been kept. It is not a democratic world state. It is an association which will be immensely strengthened, morally as well as physically, by concrete evidence that this time the people of the United States mean to be strong and ready to discharge their international obligations.

(2) It is contrary to American tradition—that is, it has never been done before.

Nonsense. It has been done, in one way or another, in the Revolutionary War, the Civil War, and the two World Wars. It hasn't been done in time of peace because we always have had time to prepare, or thought we had.



ONE IS  
DISQUALIFIED  
BY LOCAL BOARD



THREE ARE  
REJECTED AT THE  
INDUCTION STATION





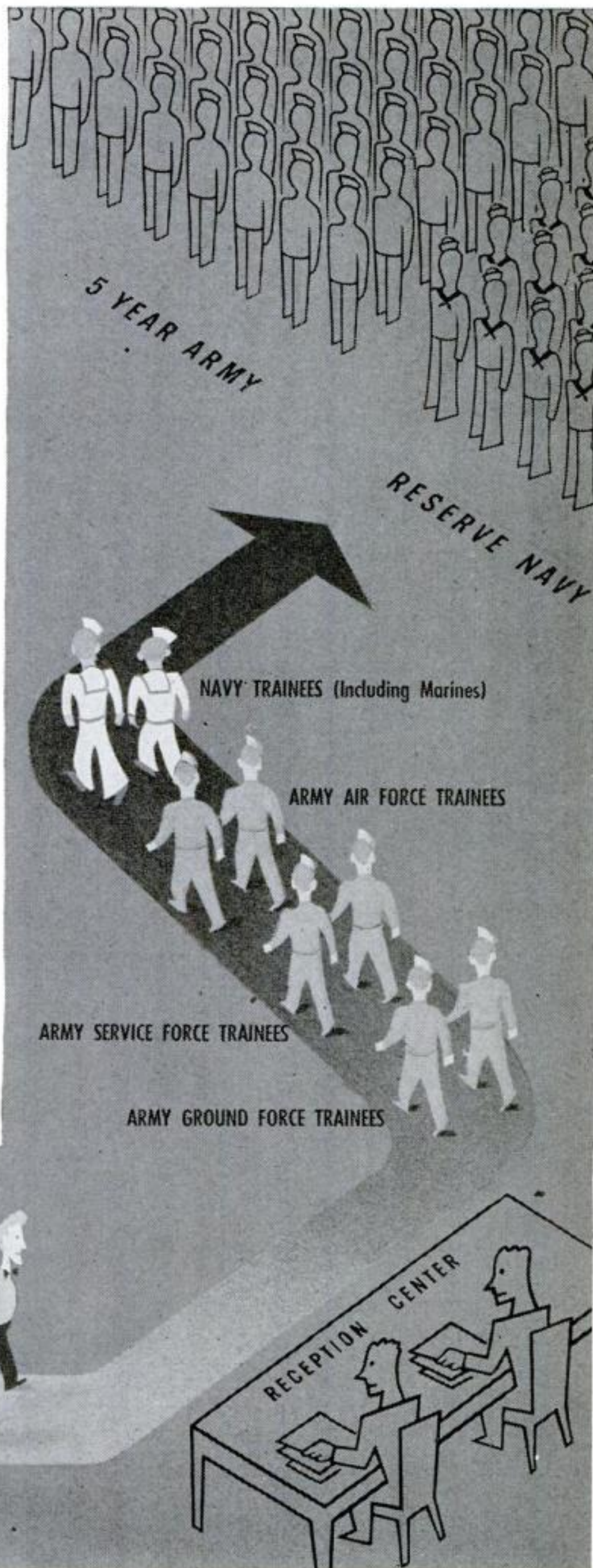
(3) It will militarize our youth; instill in them, as one learned educator put it, the maxim "don't think but obey."

Nonsense. The drill sergeants of today are highly trained specialists and technicians, and their job will be, not parade-ground roarings, but the very different task of giving our youth the basic and specialized training necessary to do their part if ever the need should come again to use the terrible mechanisms and devices of modern scientific warfare.

Now for some details. The present plan, as worked out in the War and Navy Departments may be changed here or there, but the basic principles will probably remain about the same.

In the first place, the Army and Navy won't have anything to do with the original selection and examination of the trainees. That will be a job for civilian boards in each community. The standard age will be 18, and a fresh batch of trainees will be picked every three months. The selected trainee can choose, within the limits of service needs, whether he will go to the Army or the Navy. The 900,000 trainees who are expected to be available each year will be divided between Army and Navy about in the present proportions of 8 to 3.

Some people maintain that the atomic bomb has made navies obsolete. That is more nonsense. It's a weapon that could be very effective against a battleship or carrier, of course. We have other weapons which can sink battleships or carriers if [\(Continued on page 238\)](#)





FOR BETTER LIVING  
...THE AMERICAN WAY

YOU'LL HAVE A FREEZING UNIT IN ...

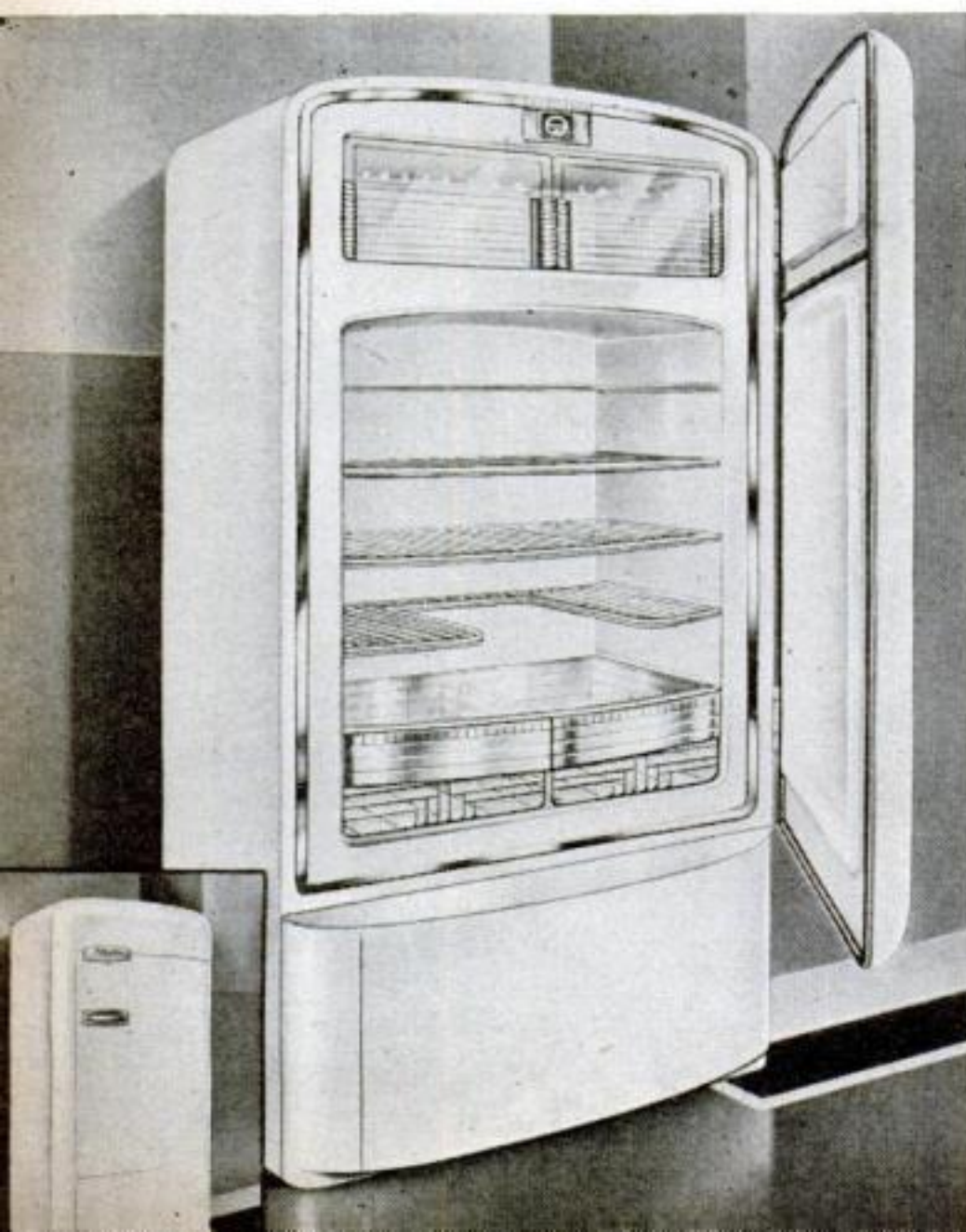
# Your New Refrigerator

**T**WO refrigerators in one—a built-in freezing locker and the regular food compartment—that is the preview of your postwar refrigerator.

A glimpse behind the curtain that hides a



This is the new Gibson refrigerator. In addition to the freezing locker and food compartment, it has a moist chamber. This section helps to keep moisture and natural flavor in meats and vegetables.



promising array of new home appliances reveals this much about the mechanical icebox of the future. And not in the dim, distant future—these will be ready early next year.

While the separate zero compartment will be the most noticeable new feature at first glance, it is not the only one. The regular food section will look different, and its functioning will be different. It will require little or no defrosting, and it will keep food fresher.

No freezing unit will be visible in the new models. The chilling coils are placed behind the walls. This leaves the food space clear and unbroken. Also, it helps to eliminate the defrosting nuisance. The chilling coils are spread over a wider area and therefore do not create one extremely cold spot for the accumulation of ice.

Over-all size of the new refrigerators will be larger than prewar models by just about the amount added by the freezing compartment. That is, the space for ordinary storage will be about the same as it was, from six to eight cubic feet. The extra bulk is taken care of in slightly increased height and depth, rather than in width. The manufacturers believe this is the most practical way to adapt them to existing kitchen wall space.

What will they cost? That will depend upon a number of factors that cannot be accurately measured just now. The manufacturers hope to be able to price them no higher than prewar models in proportion to over-all size. Operation costs will be higher because of the added size and the greater load of keeping the freezing section around zero all the time.

Three manufacturers are unveiling their new boxes to the public now. They are Frigidaire, Admiral, and Gibson. Others are known to be working along similar lines.

Radically new as they are, the two-temperature refrigerators are not a result of wartime developments. They would have been the 1942 models, in several cases at least. A few of them were actually made and sold before all factory capacity was taken over for war-goods production. This is why they will be available before other improved appliances.

No ice can form in the spacious food compartment of the Admiral Dual Temp, at the left, so no defrosting is necessary. The freezing locker, however, needs to be defrosted two or three times a year.



## HOME FREEZER



Freezing lockers will have 1½- to 2-cu. ft. capacity for storing frozen foods, freezing fresh foods, and ice cubes.



Food compartments will be from 6- to 8-cu. ft. capacity. Without cooling coils, greater humidity is gained.

**FOOD COMPARTMENT**



**NEW REFRIGERATORS HAVE TWO PARTS**



The new Frigidaire (above) has a shelf-type door on its freezing locker. This section, as in all new-model refrigerators thus far shown, extends across the top from wall to wall and has a separate door so that the temperature inside is not affected when the main door is opened. Freezing lockers can be kept at zero.

Building a frozen-food locker into a domestic refrigerator is a natural outgrowth of the vastly increased use of quick-frozen foods in recent years. With her own zero compartment at home, the housewife can have on hand a large variety of frozen foods. Also, she can freeze fresh meat and other food in her own kitchen.

The fact that the new refrigerators offer relative freedom from the defrosting task may appeal to some housewives even more than the new zero compartment. The two developments go hand in hand. Taking the familiar type of freezing unit out of the food compartment makes it automatically more convenient and efficient. With the cooling coils spread over a wide area behind the inner liner, a normal temperature of 38 to 45 can be maintained without reducing any part to 32, the freezing point.

Still another advantage results automatically from this. Greater humidity is maintained in the food compartment, and foods retain their natural juices and flavors longer.—GOLD V. SANDERS.

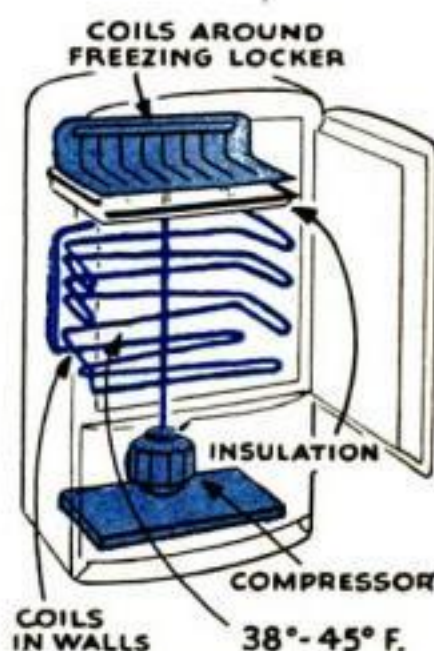
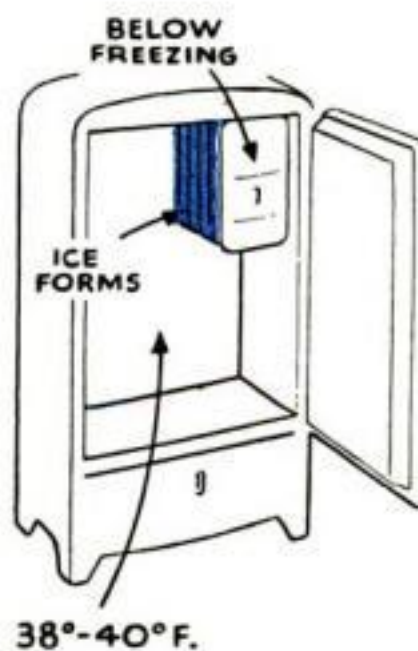
## HOW NEW REFRIGERATORS MANAGE DEFROSTING

### OLD

As air in the chamber becomes cooler, its moisture is drawn out and deposited on the coolest surface—the cooling coils. Layers of ice are built up, making defrosting necessary.

### NEW

In the new-type refrigerator the cooling coils are set behind the walls. And since no part of the regular food compartment needs to get cold enough to freeze, no ice forms.







Assen Jordanoff (seated) listens to an associate in his office while a third party may join in the conversation through Jordanoff's Jerryphone. The microphone on the desk feeds to the telephone mouthpiece; incoming voice comes via the loudspeaker.

There is no mechanical or electrical connection between the telephone and the five-tubed Jerryphone. The boxlike apparatus serves as an amplifier when the phone mouthpiece and receiver are set in place.

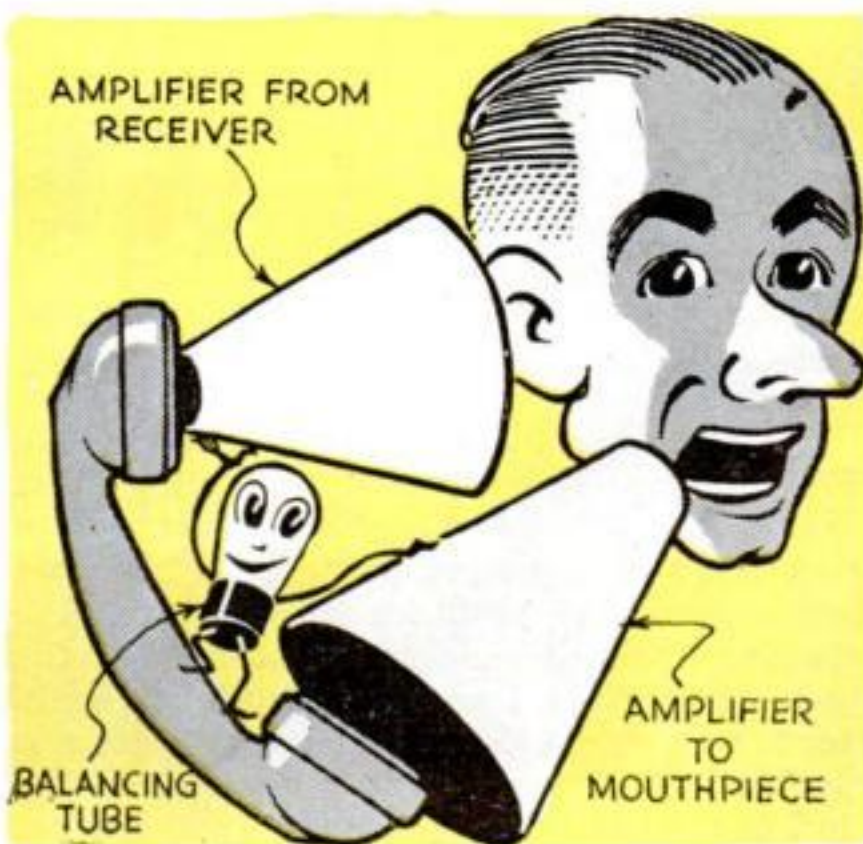


FOR BETTER LIVING  
..THE AMERICAN WAY

## The No-Hands Telephone

THE busy executive and the hard-working housewife will soon be able to talk over the telephone without having to hold the instrument to the mouth and ear. When the phone bell rings, a man at his desk will merely have to pick up the receiver and place it over two openings in a boxlike apparatus that looks like a radio set. He can then start talking, leaving his two hands free, and his caller will hear him and he will hear his caller just as if he had the earphone and mouthpiece to his head. In the home, the housewife may be bathing the baby when the phone rings. But she may go right on with her duties and hold a conversation with her caller by turning up the volume if the phone is some distance from the bathroom.

The new device is called a Jerryphone by its inventor, Assen Jordanoff, president of Jordanoff Electronics Corp. A balancing tube that automatically raises and lowers the volume going in and coming out of the amplifier prevents "feedback" into the box.



Your  
Pin Up-

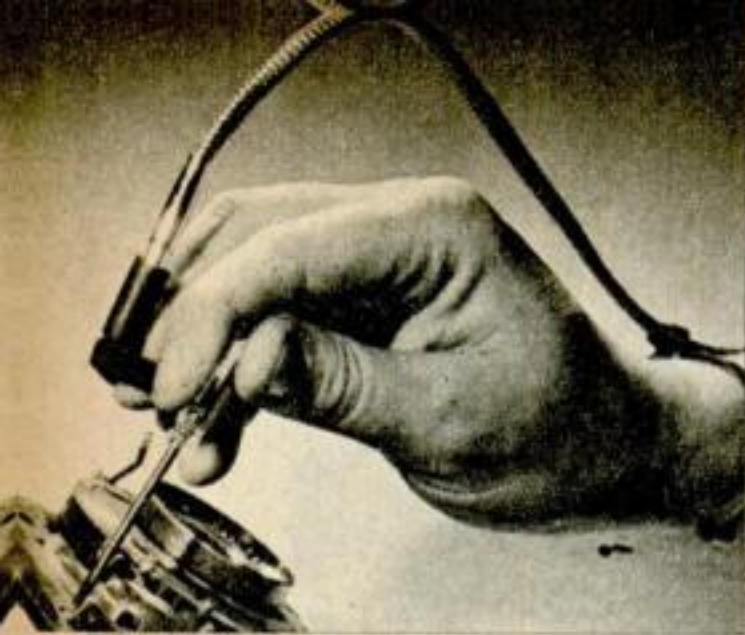
## GREAT NORTHERN LOCOMOTIVE

A 5,400-horsepower Diesel power plant snakes 106 steel-and-ply-wood freight cars around Horseshoe Curve at Blacktail, Mont., six miles from the Continental Divide. At the rear of the train, a 4,050-horsepower Diesel helps move the big load.





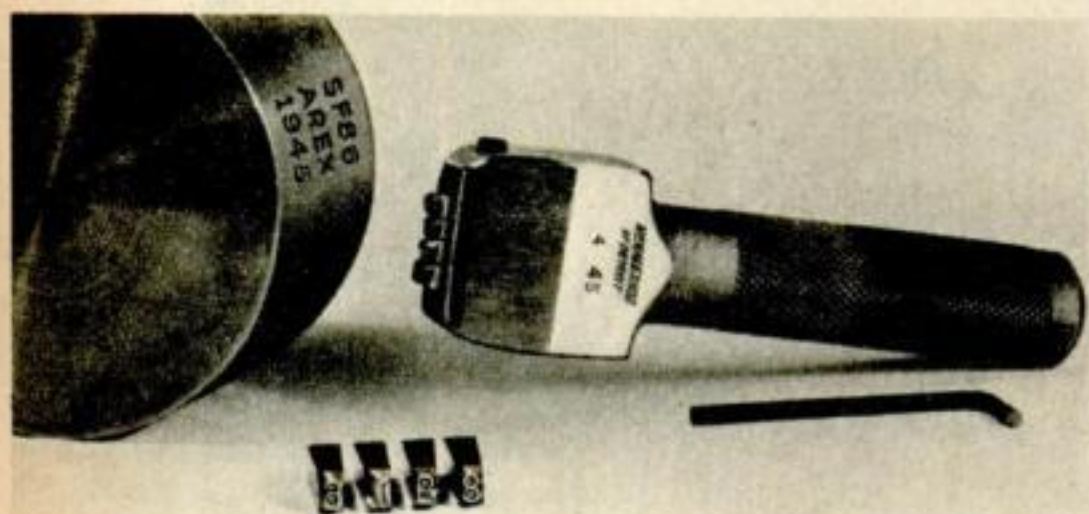




## new Tools

### Lamp Worn on Finger Lights Dark Corners

LIGHT is at the fingertips of the inspector or workman using Fingalyte, made by Universal Products Corp., Norristown, Pa. Attached to a finger or a tool, the tiny lamp is powered by a battery (left) worn on the belt—or, in another model, by A. C. house current.

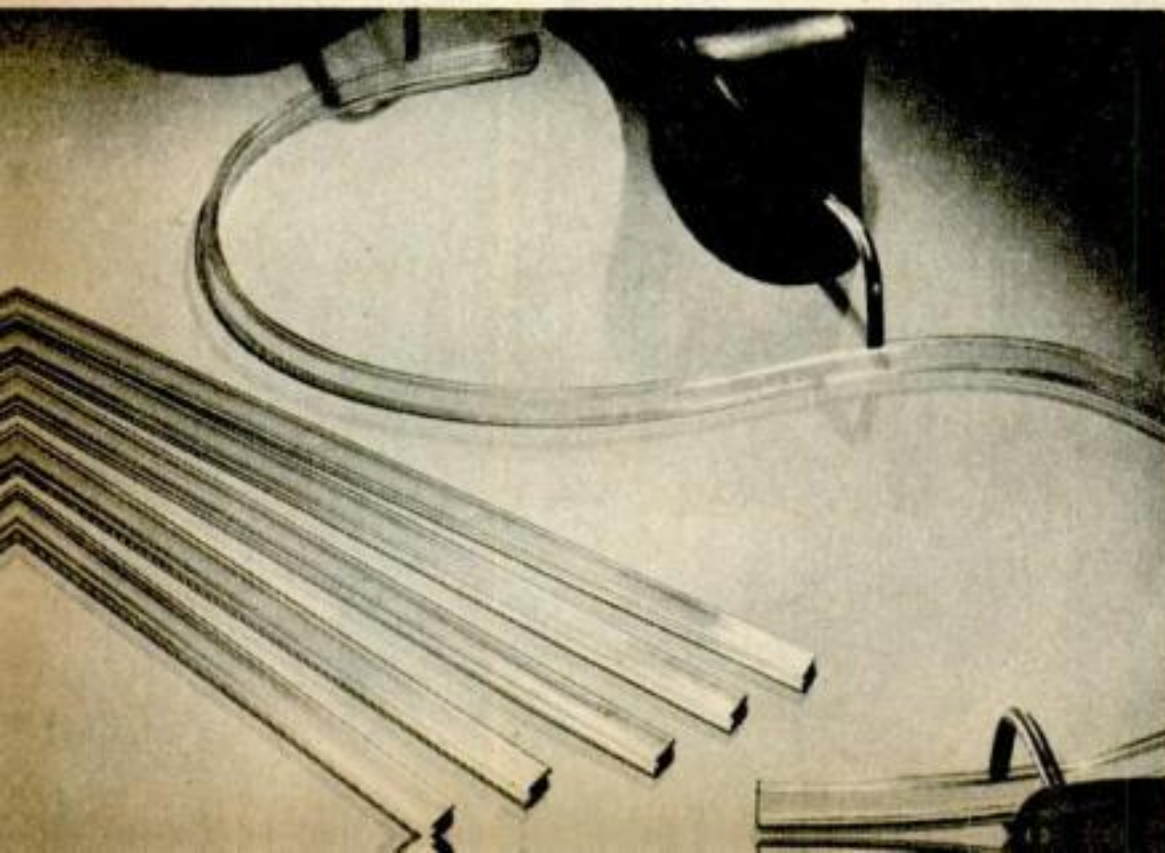


### Stamp Holder Marks Rounded Surfaces

THE rounded surfaces of bars may be marked with interchangeable steel type in a holder specially designed by New Method Steel Stamps, Inc., Detroit, Mich. One blow of the hammer makes impressions of uniform depth. Type is tapered to form the radius desired.

### Plastic Spline Maintains an Even Edge

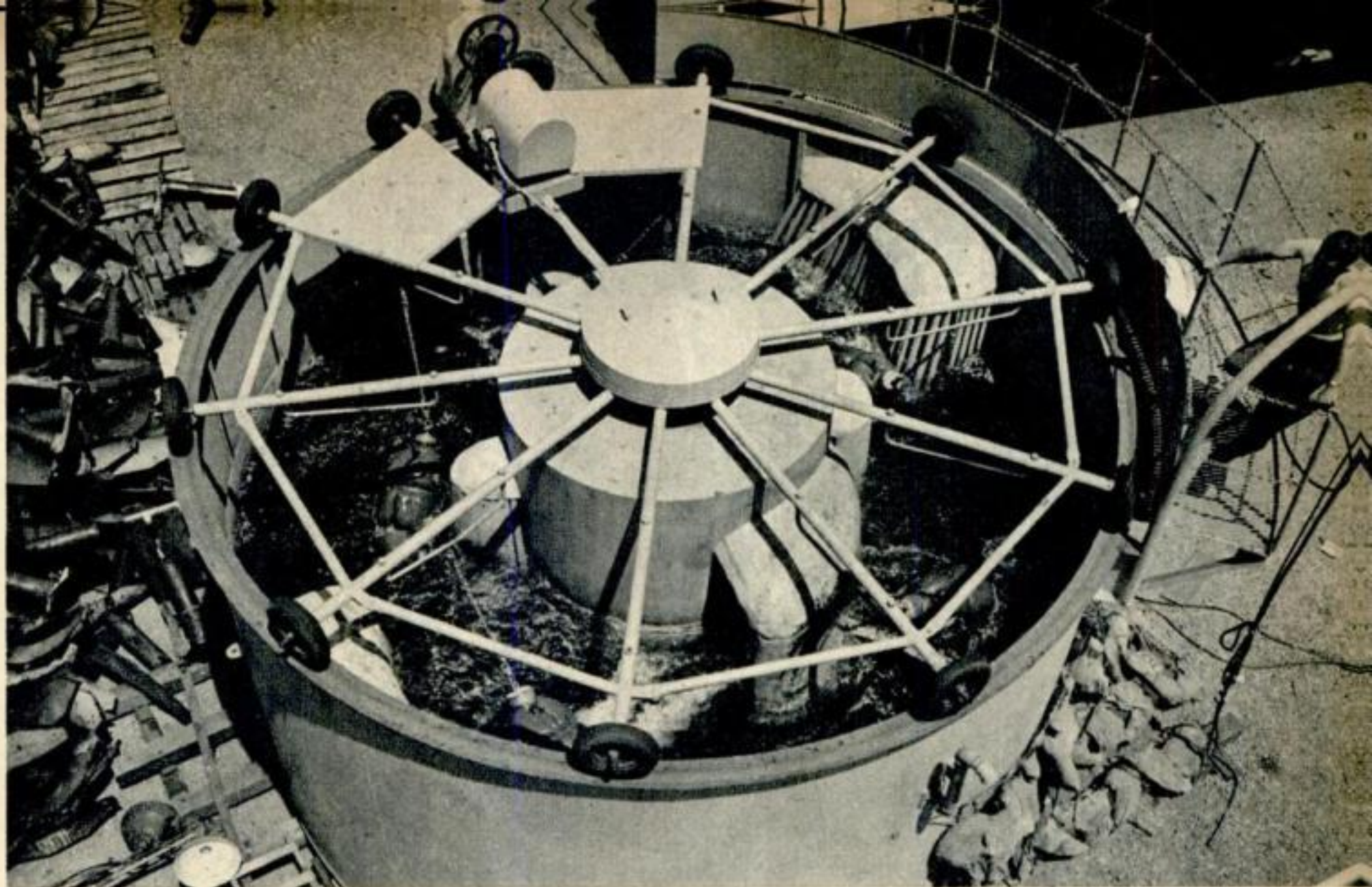
ACCURATE curves are produced by draftsmen's splines made of Tenite, a flexible and resilient transparent plastic. H-shaped in profile, they are held in place by metal dogs hooked into the channels.



### Portable Hammer Tests Hardness of Materials

WORKABILITY of materials can be tested on the spot with a portable tool announced by Steel City Testing Laboratory, Detroit, Mich. When the self-acting hammer is pressed against the material, a spring is compressed to drive a steel ball against the surface. Depth of the hole produced is measured as an indication of hardness.





Five dummies wearing sample life jackets are taking the hurdles in this U. S. Coast Guard testing tank.

## Torture Tank Tests Life Jackets

**M**EN of the U. S. Coast Guard know just how much their life jackets will stand, thanks to a torture-test machine in use at the Curtis Bay (Md.) Yard. Dragged by the arms of a revolving wheel driven by a three-horsepower electric motor, dummies wearing sample jackets slosh and bang over an obstacle course in a tank 10 feet deep and 28 feet in diameter. At 15-minute in-

tervals, the jackets are weighed and examined for damage. Tests are being run on jackets filled with kapok, fibrous glass, and cotton. In some trials, jackets take the hurdles with no water in the tank. The machine was designed by the Coast Guard's Research and Development Division on a suggestion from A. F. G. Lucas, of the National Academy of Science.

At 15-minute intervals, jackets are examined and weighed to see how much water they have absorbed.







1 2 3 4

**WESTERN LIGHT**, which is predominantly red, calls for wall decoration in a cool green tone, as shown in the room on the opposite page, green being the complement of red. The selection of green for this room is based on the Optonic System, a scientific plan formulated to provide colors which complement the prevailing types of normal light.

**Y**OU don't have to be an interior decorator to choose pleasing and harmonious color combinations for your home. Color harmony is a matter of scientific law. Research by paint manufacturers has produced various systems of scientific color selection by which anyone can choose the right colors for any job. Besides beautifying homes, color now promotes efficiency and safety in factories, hospitals, and schools. Popular Science here devotes 14 pages to a study of the new scientific use of colors.

—The Editors.

# How to Choose Colors

By **GOLD V. SANDERS**

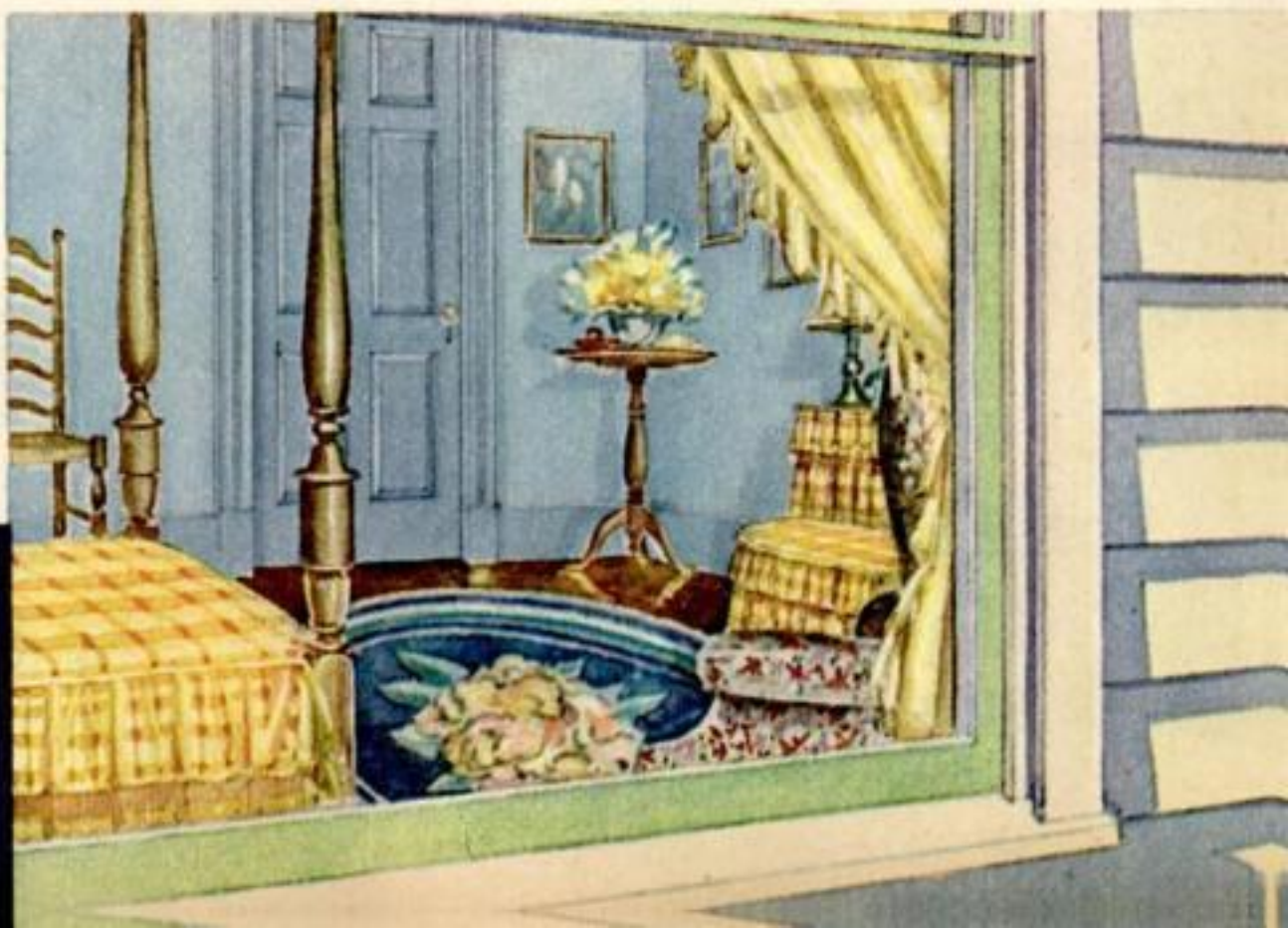
Kodachromes by **WILLIAM W. MORRIS**

**W**E'RE just beginning to put to use a great power that has always existed around us, but which we have neglected because we knew so little about it. It's the power of color. And don't think it isn't

power. When we learn that something as intimate as our blood pressure can be manipulated up and down by feeding different colors into our eyes, we begin to get a glimpse of a vast new field of scientific discovery.

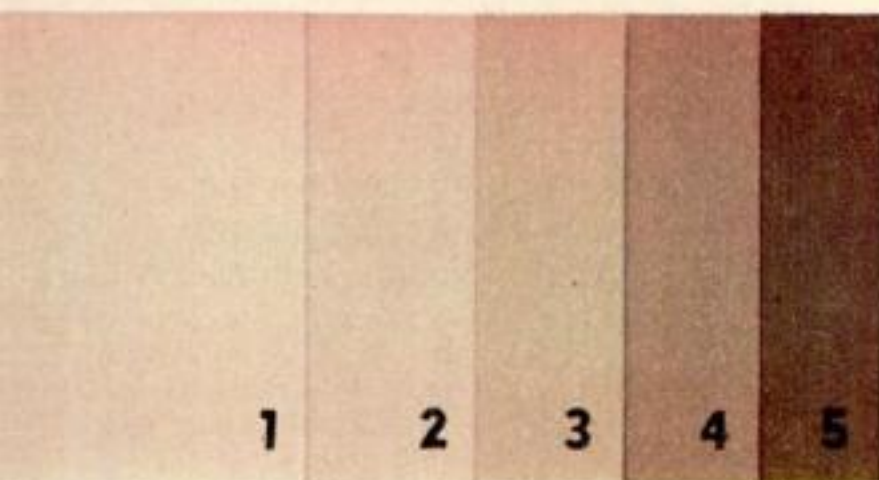
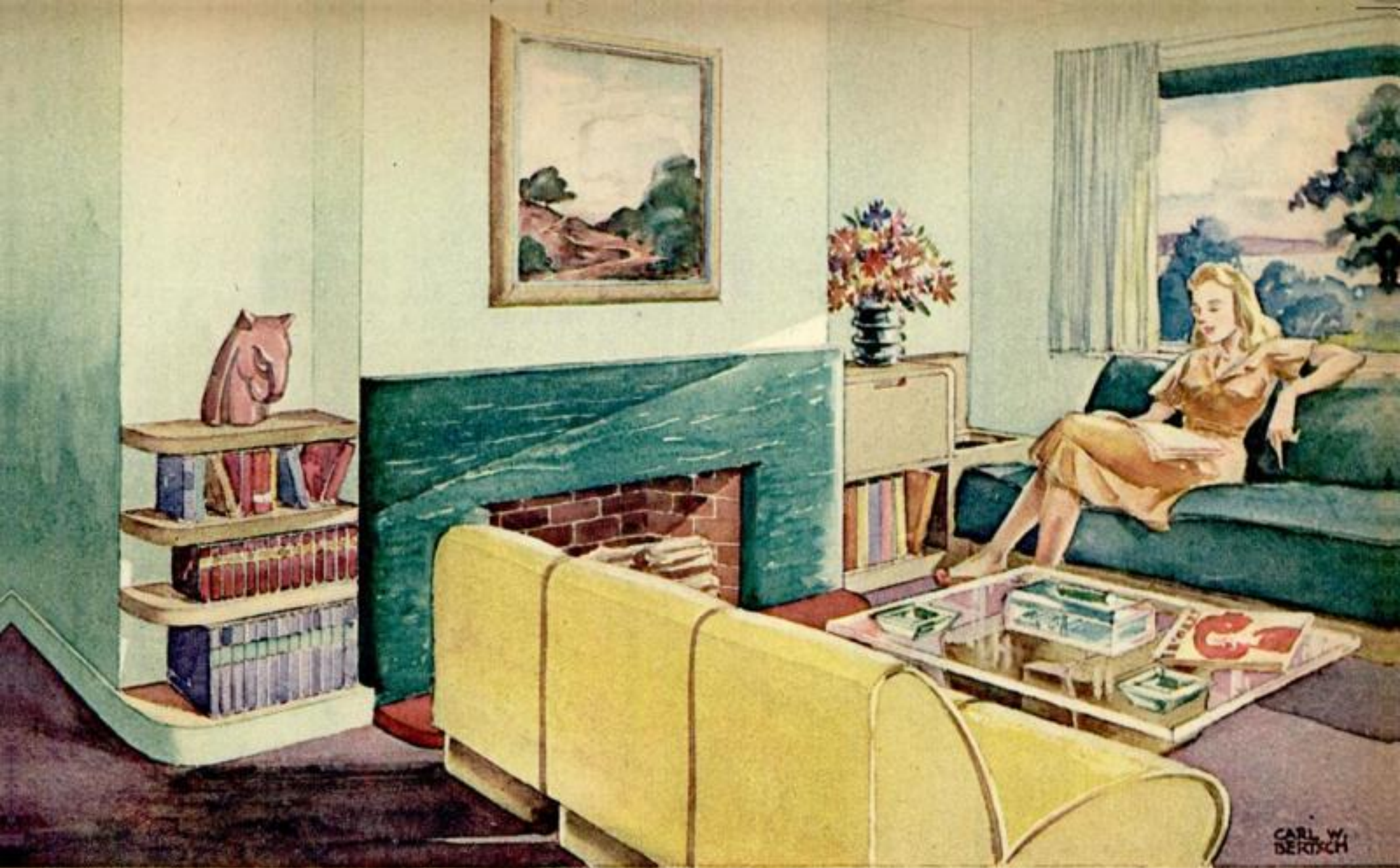
The scientists who have accurately measured this (*Continued on page 102*)

**SOUTHERN LIGHT** beams have a yellowish tinge, and for this reason some suitable shade of blue is recommended as the dominant color in a room having southern exposure. The Optonic Color System is the color plan of the Arco Co., of Cleveland. It is based on five colors—blue, green, tan, coral, and gray, each of which comes in five different shades of varying light reflection. (See charts on these pages.)



1 2 3 4

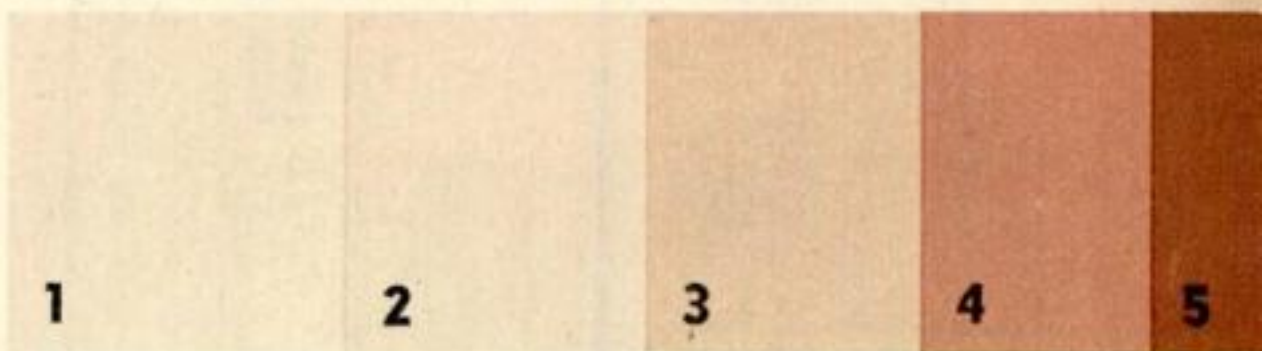




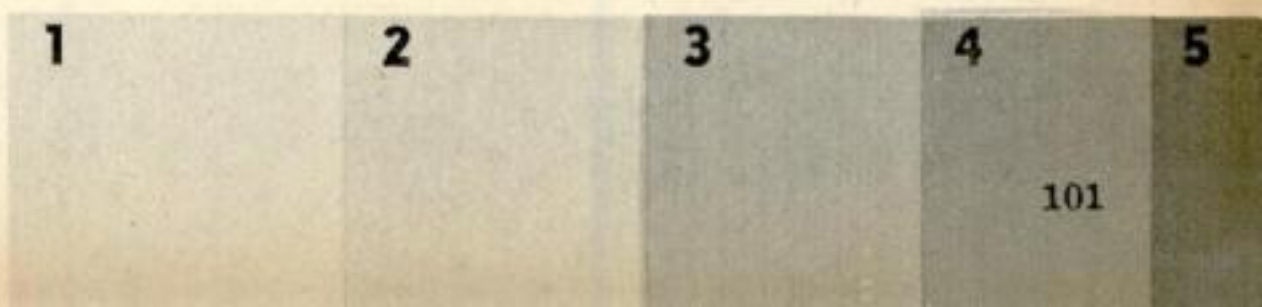
**NORTHERN LIGHT** has a predominance of cool blue rays, so the selection of the warm tan complement provides the proper contrast of hue. The basic factor in choosing room colors to eliminate eye fatigue and to be decoratively correct is to select a cool color where the predominant light in a room is warm, and to pick a warm color where prevailing light rays are cool.



**FLUORESCENT LIGHTING** of the "daylight" variety calls for decoration in warm tan or coral. White fluorescent light is complemented by gray; warm incandescent light by cool blue or green, and a combination of both by neutral gray.



**EASTERN LIGHT** is neutral, and in rooms facing toward the east neutral gray should be selected. In all rooms, ceiling should be painted white or in the shade of the wall color with highest light reflectance.





strange effect of colors upon blood pressure also tell us that our every mood is influenced by the colors of our surroundings. Some authorities go so far as to say that colors play as important a part in our mental and physical health as the food we eat. Some colors can give us greater energy, a quickening of our muscular and mental powers. Others give us relaxation, a general feeling of well-being. We can become unduly fatigued by the impact of harmful colors or combinations of colors upon the delicate nerve endings of the eye's retina.

Some of the new knowledge has already stood the acid test in great war factories, and the results are astonishing. These industrial case histories make exciting news, for they tell of increased production, improved quality of work, reduction in the number of accidents, and higher morale of workers—all brought about by the judicious use of paint. The word is spreading fast through industry, and factories from coast to coast are blossoming out in all the colors of the rainbow.

To look into a plant that has undergone the scientific face-lifting, one would imagine the interior decorators had been having a field day there. But the decorators had nothing to do with it. This is the work of scientists, not artists. The new knowledge of color's effects upon human beings came out of research, from the laboratories of physicists and psychologists,

not from the artist's studio. Broadly speaking, the science of physics tells us what color is; the science of psychology tells us what it does to us.

The happy results obtained in factories by following the advice of color experts were, of course, entirely due to the effects of colors upon the workers themselves. This being true, we can easily imagine that similar desirable effects upon us can be realized in our homes and everywhere in our daily lives. That is the next step. We can take it ourselves by learning how to follow the roads charted for us by science. This is much easier than trying to absorb the mysteries of color from artists and interior decorators.

The scientific approach has greatly simplified the use of color and dispelled much of the mystery about it. All of us can now achieve harmony by formula, being assured that good science is also good taste. If we learn to follow natural laws in choosing color combinations, we can have homes that are beautiful and colorful but whose decoration will not be a strain on the nervous system. We can have bedrooms that induce peacefulness and rest, living rooms that are somewhat more exciting but not irritating, and kitchens in which the work will be less like drudgery.

An example of directly applying to the home the scientific color plan adopted by many factories is shown on the accompanying pages.

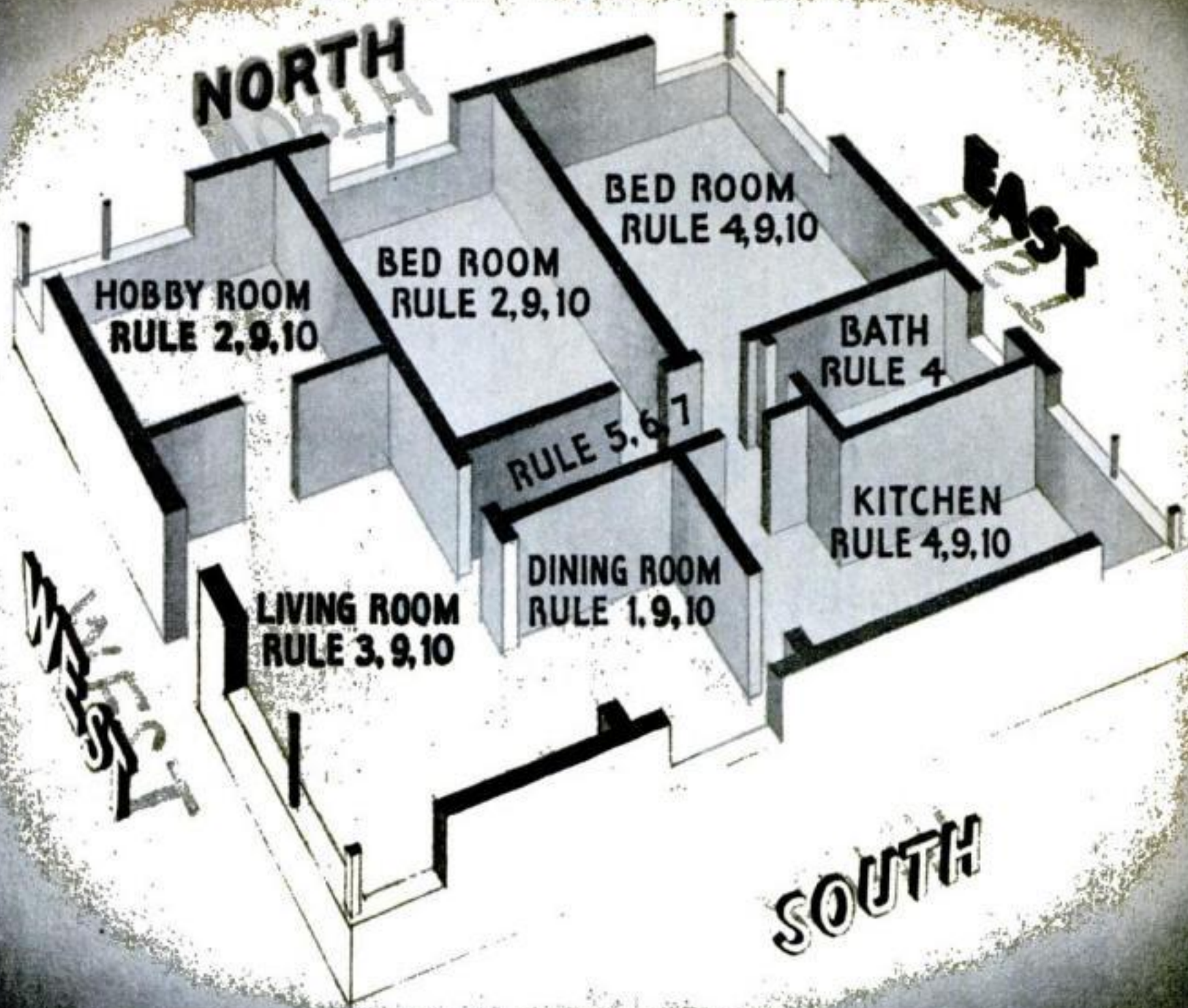
**WITH LIGHT WALLS** the accessories shown here are too dark. They provide a contrast that is irritating to the eye.

**WITH GRAYED WALLS** the accessories are painted not more than two shades darker, and the result is a good combination.

**WITH DARK WALLS** the furnishings here are too light. As in the picture at the far left, the contrast is much too sharp.







## How to Choose Colors for Your Home

**W**HEN light strikes an object, some wave lengths are absorbed, some may be transmitted, and some are reflected. The rays that are reflected constitute the color which we see. The Optonic Color System, which was developed by the Arco Company of Cleveland, provides colors which suitably complement the prevailing types of normal light and permit correct brightness contrasts. All its 25 hues—five shades of five basic colors—have been grayed to eliminate undesirable intensity.

The following rules will serve as a handy and practical guide in selecting colors for the home. Rule numbers correspond with the numbers given in the rooms of the cut-away drawing above.

1. Complement warm southern light by selecting blue, a cool color.

2. Cold northern light is best complemented by tan, a warm color.

3. Complement predominantly red western light by choosing green, a cool color.

4. For neutral eastern light, select 'gray, which also is neutral.

Where artificial light predominates, follow these rules:

5. Complement warm incandescent light by selecting 'blue or green, cool colors.

6. Tan or coral, warm colors, should be chosen to complement cold "daylight" fluorescent lighting.

7. In a room with white fluorescent lighting, use neutral gray.

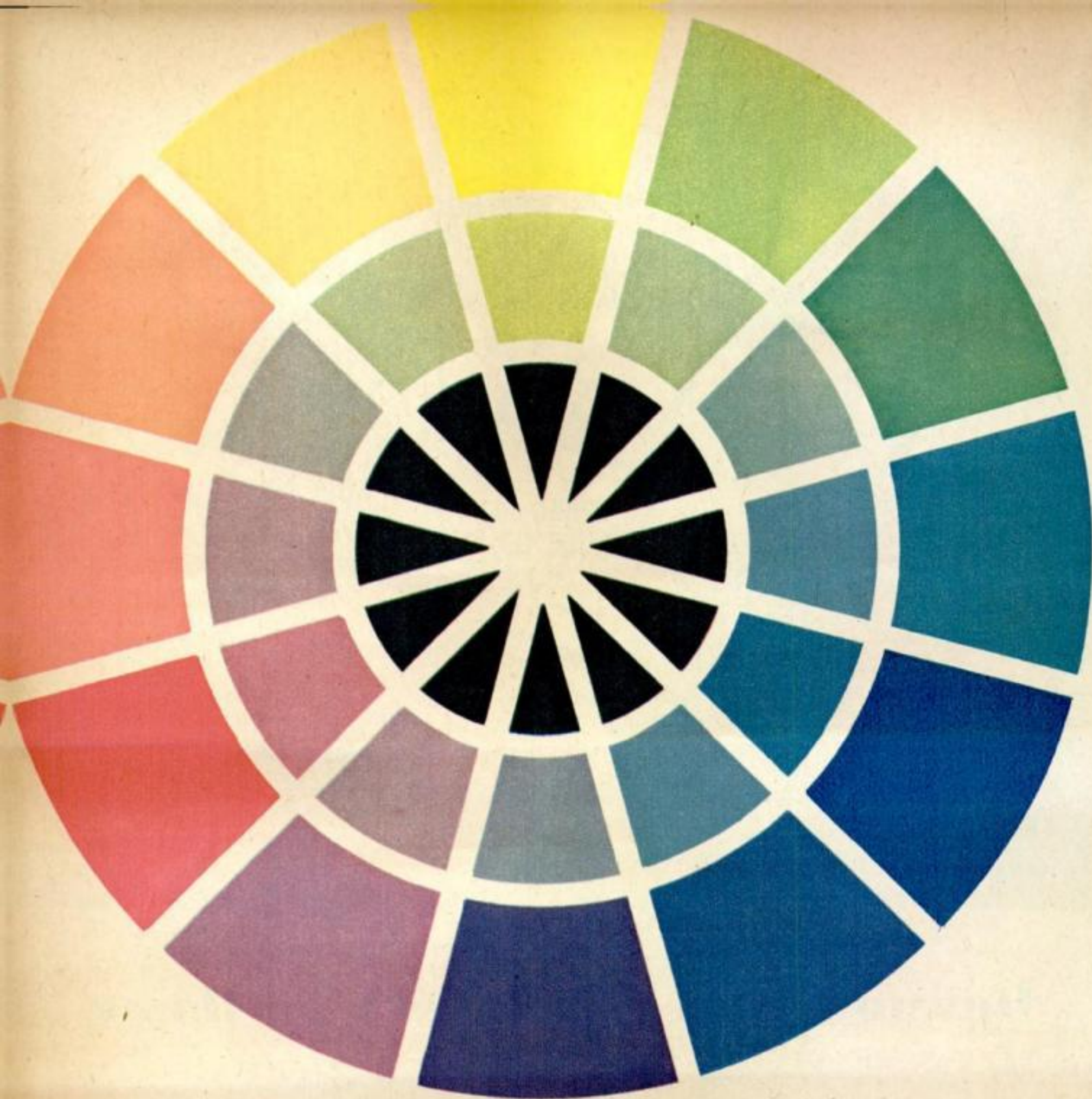
8. Under a combination of fluorescent and incandescent light, use neutral gray.

9. Ceilings normally should be painted white. If color is desired, however, use Shade No. 1 of the wall color. This has a light-reflectance value of 65 percent.

10. Rooms having a normal amount of light should be painted in Shade No. 2, which has a light reflectance factor of 50 percent.

11. Rooms having a low level of illumination should be painted in Shade No. 1.





## Choose Your Colors Scientifically

**T**HE proper use of color to obtain desirable effects upon human senses and emotions is an art based on fundamental facts proved by scientific research. Personal taste is not the important element in choosing correct color combinations. Certain

physical laws of harmony and compensation must be observed to produce pleasing results, but within those limits there is still a wide enough variety to satisfy everyone.

Yellow, red, and blue are the primary



The three primary colors (left) will form all the other hues when properly mixed. None of them, though, can be made by mixing any other colors.

Proper mixing of any two primary colors produces a secondary color. For example, equal proportions of yellow and red will create orange.





colors. From these all the hues of the spectrum can be produced, but none of the three primary colors can be obtained by any mixture.

A color wheel is produced by placing the primary colors around a circle, equally spaced. Secondary colors are then added by mixing equal amounts of pigments of two adjacent colors. Yellow and red produce orange, and this hue is placed in the circle between these two. Blue and yellow produce green; red and blue make violet, and these are placed accordingly. We now have in the color circle three primary and three secondary hues.

By using this formula of mixing equal quantities of colors that come next to each other in the circle, we can go on indefinitely producing a wider variety of hues and yet all of them will be placed in the correct relationship. The color wheel shown on the opposite page is composed basically of 12 colors, and this is sufficient to demonstrate the principles involved.

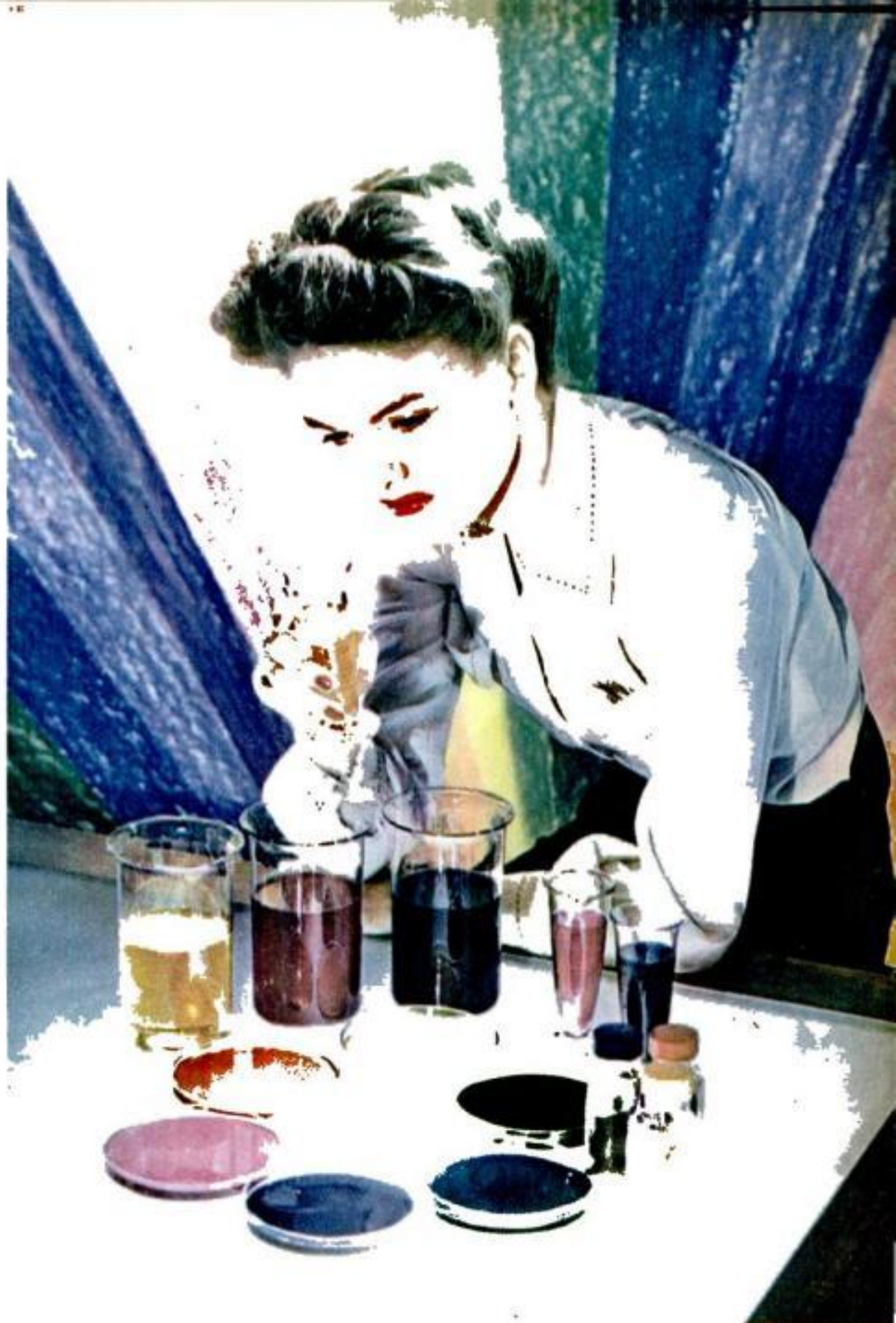
On this wheel any two colors directly opposite each other are complementary. The physical law of complementaries is exact, and has nothing to do with personal taste. A complementary of one primary color is the sum of the other two primaries. The human eye recognizes this law, as can be proved by trying the experiment suggested on page 109.

The complement of yellow, for instance, is the sum of red and blue, which is violet. The rule carries on into the secondary and all other mixtures. Make the cutout disks

Blending paints of various colors is fascinating. Commercial paints, however, are not made this way, but from special pigment materials. Paints of any one type, though, may be mixed to obtain desired hues.

as suggested on page 107 and see how this works. By making a disk like the one marked A, all complementary pairs may be readily selected on the color ring.

It is a recognized rule of color experts that one of a pair of complementary colors



Mix the primaries red and blue to get violet; blue and yellow make green. A combination of all three primaries will produce nothing but neutral gray.

Here, then, are the three primary colors—red, yellow, and blue—and equally spaced between them are the three secondaries—orange, violet, green.





enriches its mate, if used with discretion. This gives contrast without a color clash and breaks the monotony of seeing one hue alone. One color should dominate while the other gives accent to it.

We cannot arbitrarily choose colors from the chromatic scale and achieve a harmonious combination. They must have a relationship of one kind or another.

A triad, consisting of three colors equally distant from one another, is one form of harmony. Such combinations may be found on the wheel by using disk B. The primary colors—red, yellow, and blue—form one such triad. These pure colors are rather harsh, however, and their use is not recommended except for small areas. Similar triads of grayed colors are more suitable.

A more subtle combination, pleasing to the eye, will result from the use of disk C. This selects a triad called a split complement, consisting of one color used with a color on each side of its direct complement.

In everyday life, grayed colors predominate, accented here and there by one or more of the brilliant hues shown on the outer ring of the color circle. If this were not so, we would soon tire of the color violence surrounding us. Gray tones are

obtained either by mixing black with a color or by mixing two complementary colors together. An equal mixture of any two complementaries will produce, not another hue, but neutral gray. This is represented on our color wheel by the center circle of gray.

Grayed tones of a color can be obtained by changing the proportion of such mixtures, favoring one hue or the other. For example, one fourth yellow mixed with three fourths of its complement, violet, makes grayed violet. The second band of wedges around the color circle is thus produced. Richer grays are obtained by mixing complementaries than by using black to get the grayed effect. White can always be used to obtain lighter tints of colors.

Disk D combines all the harmony principles we have discussed. Here the grayed colors are found to be predominant because we may use them over greater areas without tiring of them. The smaller openings in the disk indicate the proper use of the pure colors to enrich the grayer masses. Any or all of the colors showing through the openings in this disk may be used together to achieve a pleasant and harmonious combination.

## How Color Is Used in Factories

**T**HERE are several thousand factories in this country—mostly large ones—that present an entirely new aspect these days. The machines, as well as walls, floors, beams, and pipes are painted in colors where before there was nothing but dingy grays, greasy blacks, or at best some white. The color is not there to beautify the places, but to improve working conditions.

The first consideration of the color experts is for the eyes of the workers. A well-considered use of color has been found to be of immense value in giving clearer vision at working areas and in preventing eye fatigue, which quickly results in general bodily distress.

A superabundance of light does not answer the purpose. On the other hand, it often adds to the difficulties of concentration on the job. Glare dazzles and fogs the vision. To avoid this, factory walls are now painted in shades of green, blue, gray, or tan so that areas in the line of a worker's vision do not present a sharp contrast to the work area.

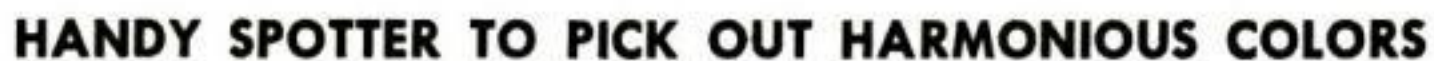
Machines also are painted in more than one tone of color. The working area is given a hue that will contrast, but not too sharply, with the material being worked upon. Surrounding parts of the same machine will have a different color to relieve

the monotony that has been found to cause eye fatigue and irritability. If a factory worker has his eyes glued upon one color for some time, the nerve endings begin to demand the complementary color. This physical phenomenon actually causes spots before the eyes, called aftervision.

But a mere splashing of colors around a plant to make it look gayer will not obtain desirable results. More likely it will add to eye distress. To simplify this problem for plant owners and managers, the large paint manufacturers have devised basic formulas and systems of color selection that can be fitted to all kinds of factories. Their color experts consult with factory management and advise them how to obtain a harmonious whole, with walls, ceilings, machines, and working areas painted according to scientific color principles.

While each factory presents certain individual problems, the general plans developed by the paint manufacturers serve as guides. Du Pont calls its system "Color Conditioning." That of the Pittsburgh Plate Glass Co. is named "Color Dynamics." The Arco Company has what it calls "Optonic Colors." Sherwin-Williams has a "Color Harmony Program." All are based on accepted color *(Continued on page 108)*









This is how harmonious combinations show through holes in the cut-out disks.

principles. The factory owner who does not wish to call in a color expert can obtain approximately the same results by following one of these systems.

Aside from the working rooms, there is still other color, and brighter, much in evidence these days. Rest rooms, cafeterias, and hallways often are decorated in quite gay colors. The purpose is to give employees a lift in spirit during off moments. Here the color schemes are more akin to those used in interior decorating.



Draperies, upholstery, walls, carpets, and accessories that harmonize provide physical and mental comfort. Overuse of pure primary colors must be avoided.

Personal taste often is misleading in choosing correct color combinations. Certain physical laws of harmony and compensation must be observed to produce a pleasing decorative scheme.



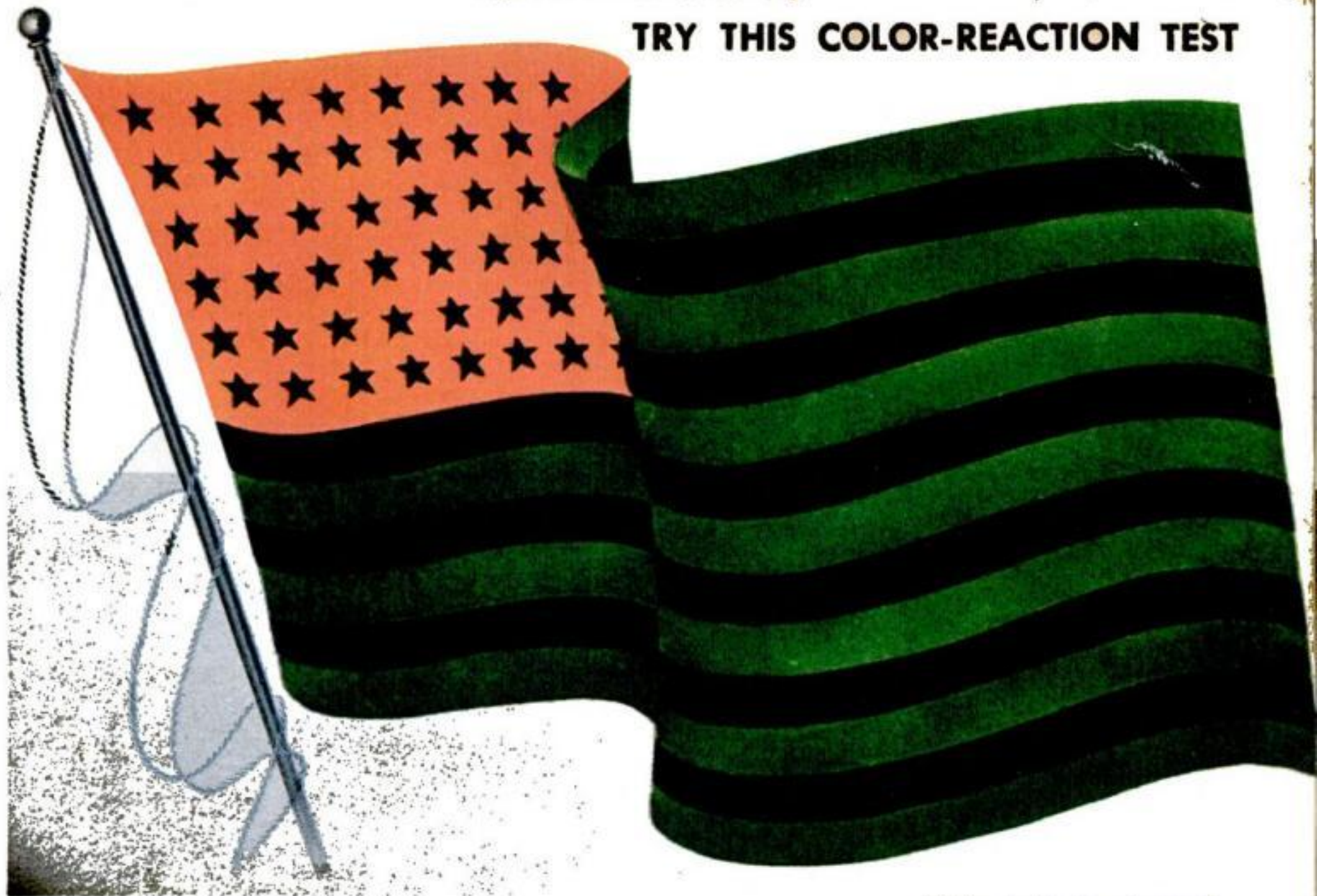
Effective colors, for use in fabrics and wallpaper can be chosen with confidence when the color wheel is used as a guide.

Also, eye-pleasing combinations in wearing apparel are the result of a thorough knowledge of the use of color by stylists.





## TRY THIS COLOR-REACTION TEST



(Picture by The Arco Company)

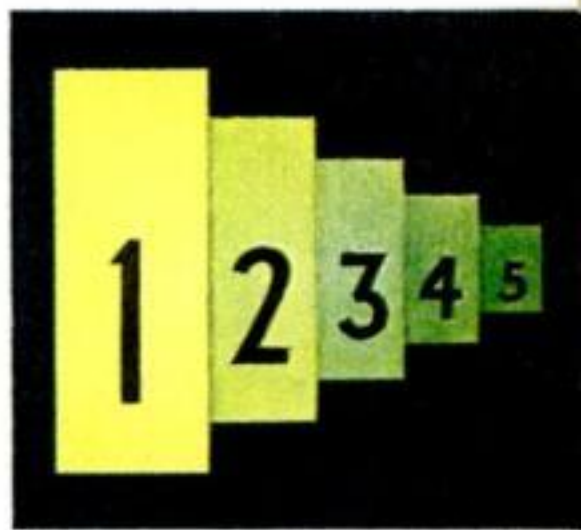
Nature rebels at an overdose of one color by generating within the eye the complement—or opposite—of any color the eye is forced to look at for long periods. Here's the proof. Stare at this strangely colored flag for 30 seconds, then look at a white surface. You will see Old Glory in its true colors.

**MEN** have a liking for blue or shades of blue.

**WOMEN** prefer red or tones of red, tests show.

**BACKGROUNDS** may emphasize or minimize an object. Both of these arrows are the same size.

**ILLUSION.** Areas painted in warm colors tend to advance toward the eye; cool tones recede.



(Pictures by E. I. du Pont de Nemours & Co.)

**WARM** tones are linked with light and heat.

**COOL** ones compensate for heat, are soothing.

**VISIBILITY** is heightened by extreme contrasts in color value, but should be held to small areas.

**LIGHT VS. DARK.** Light colors create an illusion of bigness. The disks below are of equal size.







## New and Better Paint Is Due for Civilians

**F**OR the country-wide face-lifting job on our homes that is sure to come after the war we shall have a great variety of excellent new paints and varnishes with the very qualities we have always wanted. The manufacturers of the things we use—automobiles, furniture, and the whole line of civilian goods—also will have a vast array of better coatings to apply at the factory.

The paint makers have learned much during the war, because much was asked of them in the way of protective coatings for military and naval equipment. They have had to devise materials that would endure the severest climatic conditions all over the world. Extremes of cold, heat, and dampness such as we never encounter in this country have been met and licked by the thousands of chemists and engineers engaged in research and manufacture in the paint industry.

For interiors we are promised: quick-drying, washable, and nonsmelling paints, varnishes, and enamels that can be applied easily over old paint, wallpaper, calcimine, fresh plaster, and porous wallboard.

For exteriors there will be: paints of greater durability, highly resistant to weather, temperature changes, dampness,

fungus, and all the elements that have made repainting necessary at short intervals.

Colors, too, we shall have in greater variety than ever as an aftermath of a world war in which camouflage has been as important as the weapons it conceals. Development of new and more color-fast pigments has gone hand in hand with the creation of more durability. The War Department is using 74 different shades of color.

Perhaps nothing interests the home owner more than the prospect of being able to cover a surface with one coat instead of the two or three generally required. The hiding power of these new paints is due to the development of more efficient pigments. Among these are titanium and zinc. We are promised one-coat oil paints and enamels that will give us a smooth and effectively covered surface on all interiors whether of wood, plaster, wallpaper, concrete, brick masonry, or calcimine. A one-coat paint for exteriors is yet to be achieved, but paint makers are working on it.

Quick-drying paints, varnishes, and enamels were on the market before the war, and these will come back strong with notable improvements. The resins with which they are made are just about completely monopolized for direct or indirect war uses. These materials are virtually the same as the familiar plastics, but in fluid form. The paint industry and the plastics industry, in fact, are becoming more

and more closely associated. A large part of the new developments in paints, varnishes, and lacquers is based directly upon these same synthetic resins.

Some of the new formulations are so important that they are veiled in secrecy—so valuable to us in war that we do not want the enemy to make similar use of them. That fact itself is an indication of genuine progress in paint making.

Early in the Pacific war, the armed forces found that their radios became useless in the tropics because of fungus growths. The paint manufacturers were called upon to solve the problem, and they did. The fungus-resistant coatings developed in this emergency will be equally effective in our own semitropical regions and wherever there is a problem of mold due to dampness.

We may be able even to get rid of flies,





mosquitoes, and other insect pests by putting the powerful killer DDT into paint. Two British chemists have been making experiments along this line with remarkable results. They confined flies in an enclosure painted with a five-percent DDT coating and all the flies died. In a small room similarly treated, 90 percent of the insects were killed. The coating still had its killing power after two months. However, they have not yet succeeded in incorporating the DDT in a finish of great hardness.

No less important than the new paints that will be available for general use will be those especially designed for application to all sorts of products at the factory. Here are some of the things manufacturers may expect:

Rust-retardant primers more efficient than ever before, for all kinds of metal. Heatproof paints that may be put on extremely hot surfaces such as furnaces and smokestacks. Flameproof paints. Lacquers of such high solid content that about half the usual number of coats will be required. Solid paints, without solvents, to be applied in molten state by steam or air pressure. Plastics to be heat-sprayed as an outer coating. Silicon insulation varnishes so resistant to heat that they make possible electric motors of about half the normal size for the same horsepower. Luminescent and fluorescent pigments at about one tenth their prewar cost. Paints that may be put directly on a wet surface. Varnishes, paints, and enamels of greater uniformity due to development of standardized drying oils.

Methods of applying in factories have been similarly improved, and this is equally important since about half the cost of a paint job is the application process. Here are some of the new methods:

*Electrostatic spraying and detearing.* A high-voltage electrostatic field is used, with the article to be painted attached to the positive pole. A charge is imparted to the sprayed particles, causing them to be attracted to the article. A uniform coating with extremely small loss of material results. The same electronic equipment is used also to draw off excess paint after dipping.

*Infrared baking.* Dipped articles are passed between batteries of infrared lamps on a conveyor, the enamel being baked in a few minutes.



*Hot dipping.* This method is now in wide use for applying strippable coatings of ethyl cellulose to machinery and parts for protection during overseas shipment. It is expected to increase in general use after the war, with various other plastics being employed.

*Hot spraying.* Varnish, lacquer, paint, or airplane dope is applied by spraying from a steam-heated or electrically heated atomizer. Thick coats harden quickly, speeding the production process.

*Automatic spray-painting.* The need for painting millions of shells, bombs, and cartridge cases of all kinds has resulted in immensely faster automatic spraying machinery that will doubtless find other industrial uses when war ends.

*Flame-spraying.* By a process similar to the flame-spraying of molten metal, one of the newest plastics, polyethylene, has been successfully sprayed as a coating. It is believed that other plastics may be similarly deposited, though little has been done along this line as yet.

As a result of the war, and also of prewar research, the whole paint industry has undergone a radical change, passing rapidly from the general practice of using natural raw materials to the creation of its own materials through chemical know-how.

We shall find that almost all the many types of protective and decorative coatings will be entirely different and much better than in the past.







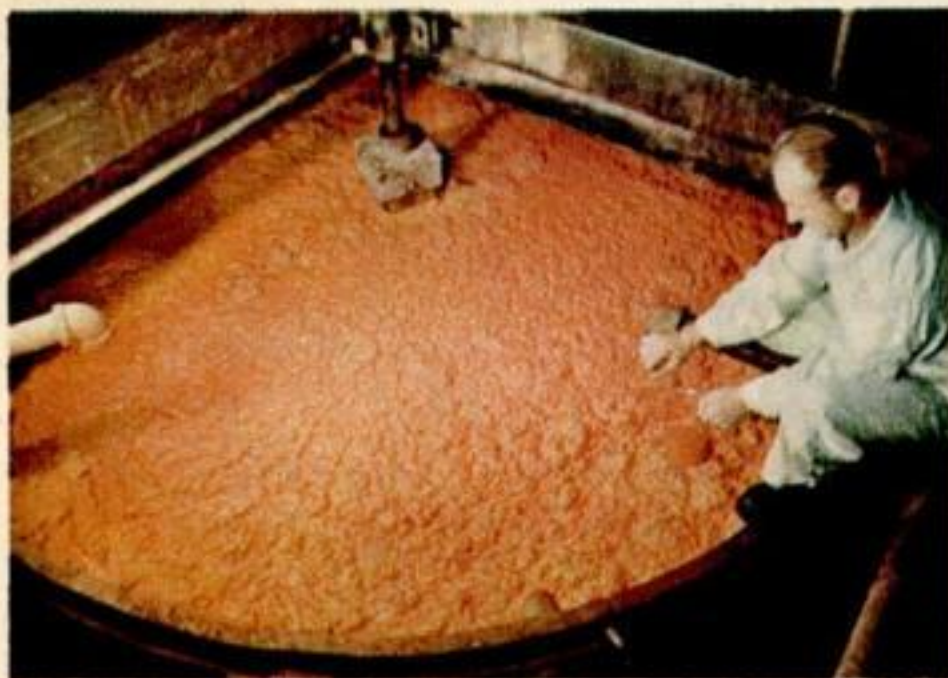
A technician (right) takes gobs of pigment for testing in control laboratory.

The wet sample (left) is tested. Then it is dried, pulverized, and examined further.



At the lower right, men separate press plates on which wet pigment has adhered.

After the pigment cakes have been kiln-dried, they are broken up and stored in big tubs (below).



(Kodachromes by Pittsburgh Plate Glass Co.)



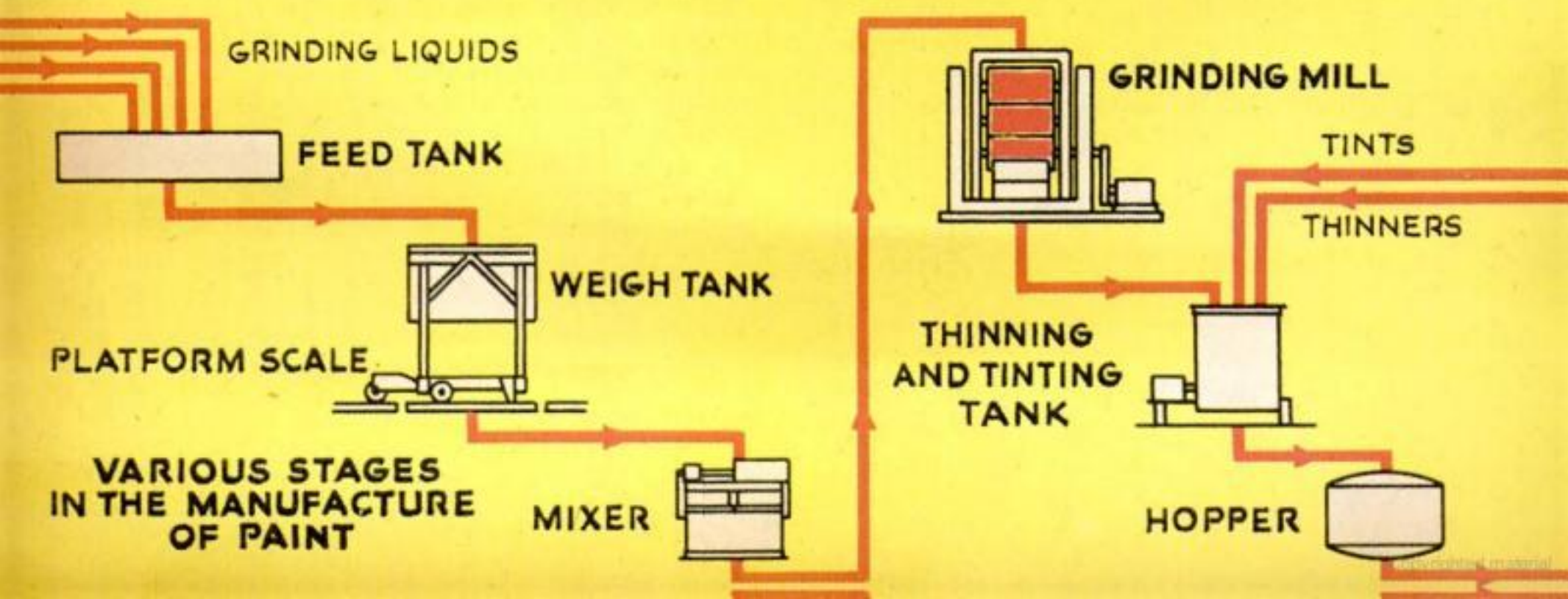
## Making Paint Pigment

**M**ODERN paint manufacture no longer depends upon finding its pigments in nature. The colors are created by chemistry. In the precipitation process, pictured here, various solutions of chemical in-

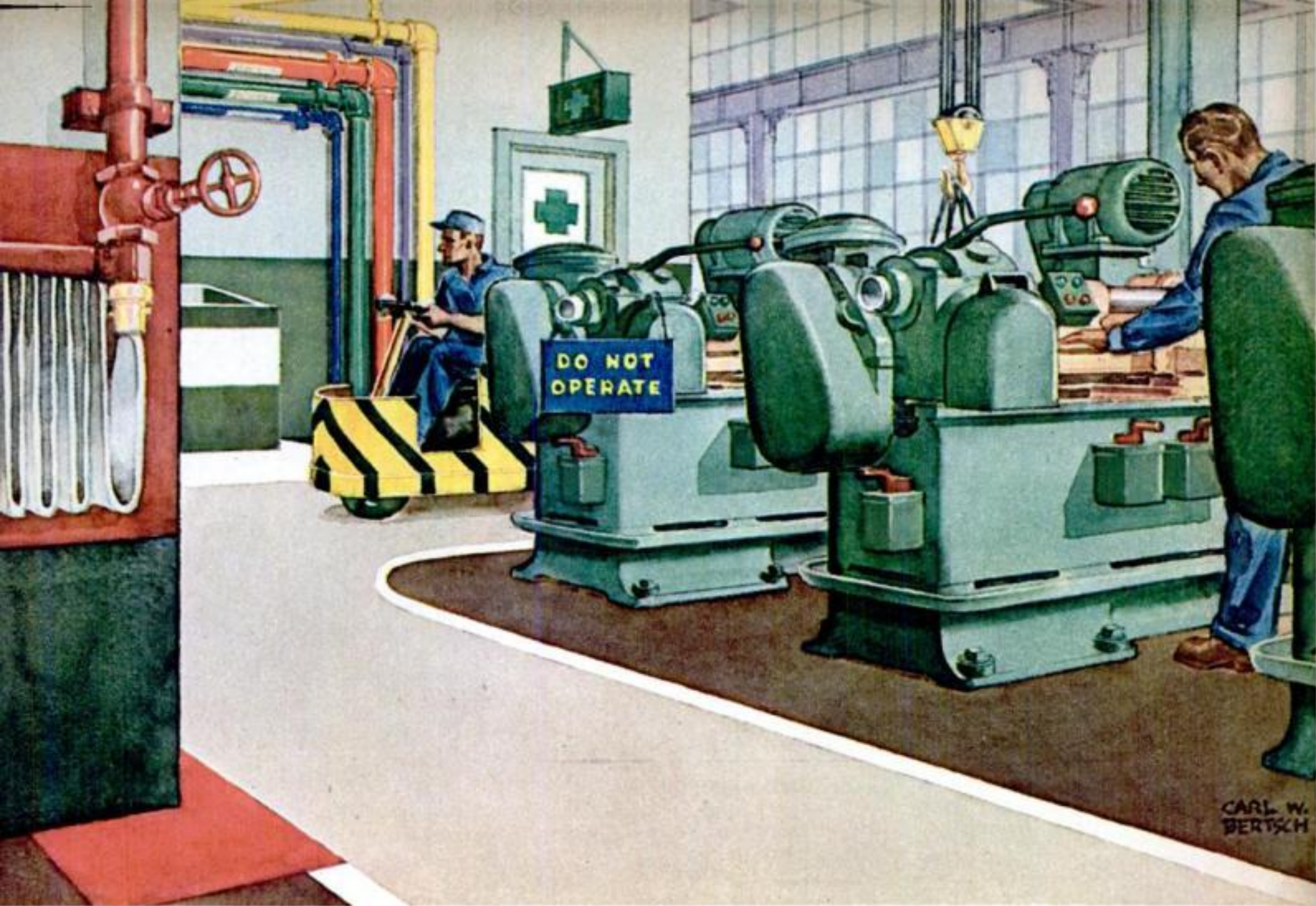
gredients are brought together, and the reactions between them produce the desired color as you watch.

Water solutions of these chemicals are made in wooden vats, separately at first. They are then brought into another great vat, each in definite order. Here the reactions take place, as the solution is mixed and stirred by a mechanical agitator.

The precipitated pigment is insoluble in water. Pigment falls to the bottom of the vat, the water is siphoned off. The wet pigment is then put in presses and removed in cake form. These cakes are first air-dried, then placed in a kiln where all remaining moisture is removed. The remainder of the pigment-making process consists of breaking up these cakes into chunks and grinding them into powder.







This is how the scientific application of color can transform a factory from a dreary cell to a cheerful workshop. It promotes safety and sanitation, increases employee efficiency, and keeps morale at high level.

## Safety Color Code for Factories

**B**ECAUSE the human eye responds so readily and willingly to colors, a number of large factories have set up standards of marking by color so that employees will be warned at a glance of certain hazards. Carrying this idea still further, the American Standards Association has adopted a Safety Color Code which it hopes will become a standard in factories from coast to coast.

If such a standard is widely employed, it will mean that a worker going into a new factory will find familiar colors to tell him what he needs to know about avoiding accidents to himself and others.

The safety code colors finally adopted by the association and now under consideration for industry-wide acceptance are:

**RED** for identification of fire-protection equipment and fire-fighting equipment; for danger; for "stop." Since the use of red for such purposes is already widespread, as for instance in traffic lights, this was considered the logical standard.

**YELLOW** is suggested as basic standard for designating caution and for marking such physical hazards as: striking against, stumbling, falling, tripping, and "caught

between." Solid yellow and yellow and black stripes or checkers are suggested as effective methods of using this color. Thus yellow would be used for marking factory power trucks, crane pulleys, traffic warning signs, and so on. Some factories have used orange as the color for this purpose. The association advises against this because orange is a mixture of yellow and red, and might lead to confusion.

**GREEN**, universally accepted as a safety signal, is suggested for all such uses as marking the location of first-aid kits, gas masks, deluge showers, safety starting buttons, exit signs, and anything else in the factory connected with the idea of safety.

Previously adopted standards already in wide usage call for the painting of factory pipes in accordance with the class of liquids they convey, such as safe products, dangerous products, protection materials, and extra-valuable materials.

Another adopted standard of great economic value in factories calls for the painting of grease cups and oil holes to correspond with the colors on oil cans and other oiling equipment so that the right grease or oil will always be applied.

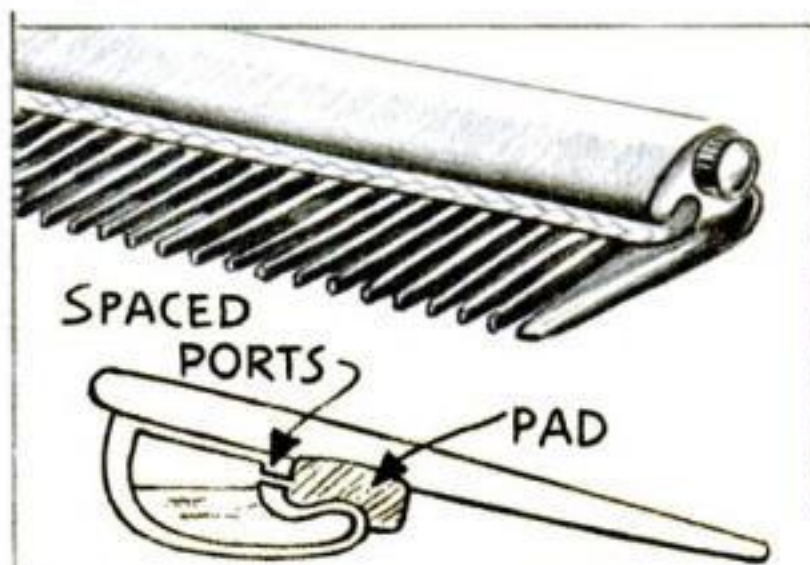




**CAMERA SUPPORTS.** For people who want to take snapshots without anyone being the wiser, John L. Johnson, of Pinehurst, Wash., has devised a camera support that can be worn on the head under a hat. The lens, pointed through a hole in the hat's crown, is aimed by means of a sight on

the brim, and the shutter is operated by a cable leading to a pocket. Straight-from-the-shoulder pictures are possible with the gun-stock support above, invented by Leo J. Du Mais, Chicago. Strapped to the shoulder, it provides a steady rest for shooting at any camera angle.

**GET 'EM WHILE THEY'RE HOT!** And hot dogs are always hot when they come from this coin-in-the-slot frankfurter vending machine. When the customer deposits his coin, out comes a hot weenie on a bun, neatly wrapped in a paper napkin. Cooking is done instantaneously by an electric heating arrangement including a diathermy coil. The inventor is Everett P. Ford, San Francisco.



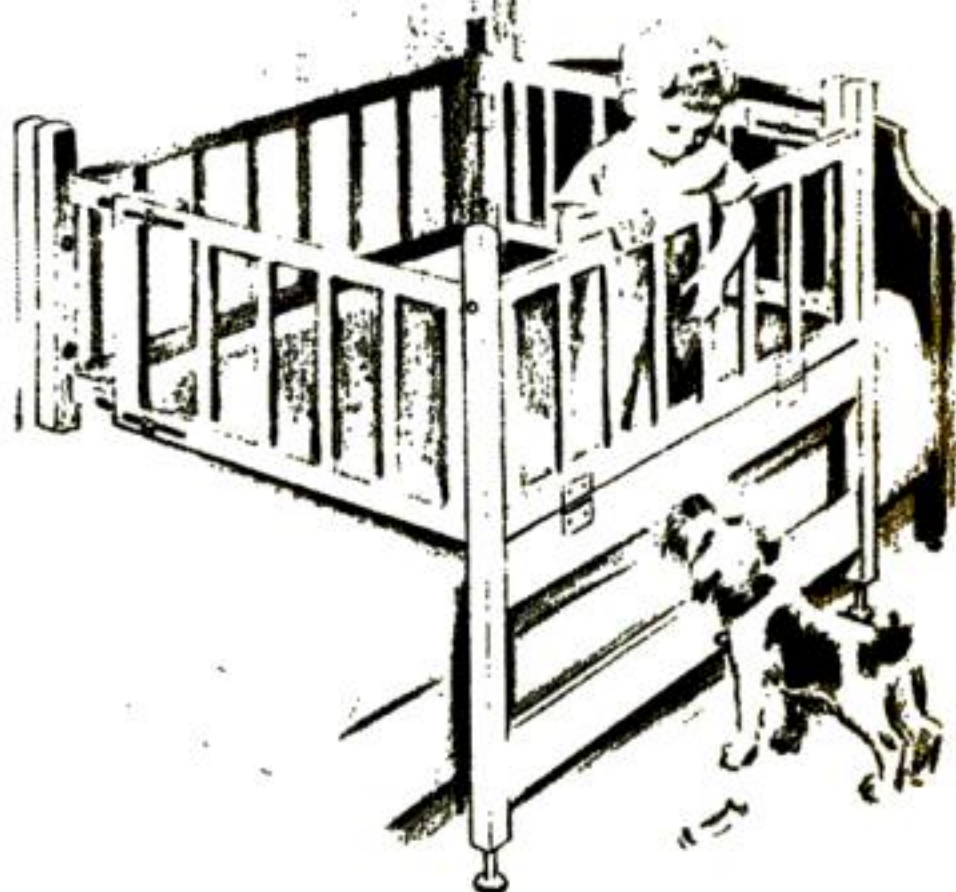
**HAIR WILL STAY PUT** when one uses this kind of fountain comb originated by William D. Pyle, Indianapolis, Ind. A reservoir at the back of the comb holds water or other liquid, which is gradually released through an absorbent pad at the base of the teeth as they are drawn through the hair. The comb will not leak when it is laid on a flat surface, reservoir downward, and can be used with either an up or down stroke.





## the inventors

**ANY SINGLE BED IS A CRIB** for the baby if one of these adapters is used. Looking a good deal like a play pen on stilts, the device is, in effect, a folding fence of variable width that can be fitted over a section of any usual-sized couch, single, or day bed. The legs are adjustable for length so that they can be made to reach the floor on both sides, and the feet are rubber-shod to prevent slipping. Advantages include saving of space ordinarily required for a crib, and portability when it is necessary to travel with a baby. The hinged lengthwise side can be let down for easy access to the child when it needs attention of one kind or another, and the whole guard is easily removed for making the bed. The inventor is Milton N. Redman, Tompkins Corners, N. Y.



**FOUNTAIN TOOTHBRUSH** makes it possible for you to brush your teeth without having to hunt for the dentifrice. A reservoir in the handle holds the liquid cleaner, which is fed to the base of the bristles through a bore in the shank. The container, which can be removed for refilling, is unscrewed slightly to permit the dentifrice to flow. Tightening prevents leakage when the brush is put away. William K. Kiff, Buffalo, N. Y., originated the device.

### Uncle Sam Now Helps Inventors to Find Customers

TO BRING inventors and manufacturers together, the U. S. Patent Office has started a new service. Patents available for licensing will be published free in the Patent Office Register at the owners' request and remain there unless the owners withdraw them. When asked, the Patent Office will furnish classified lists of patents to manufacturers. Charles F. Kettering suggested the idea.

**CULTIVATING WITH WIRE.** Instead of having blades like small plowshares, this garden cultivator, invented by Edward Terray, Hubbard, Ohio, uses a wire. Stretched between posts at the ends of a tubular support, the wire is pushed through the soil about one inch below the surface, breaking it up and cutting weed roots.





***What* CAN YOU  
TELL ABOUT  
THIS SERGEANT?**





# His Story Is on His Jacket!

**I**N CIVILIAN life, a clerk might pass for a bank president—and vice versa. In the armed forces it is different. Here every man wears distinguishing marks that tell how important his job is, what his training and experience have been, and whether he has distinguished himself in any way.

Look at the picture of Sgt. John B. Welde on the opposite page. Anybody can see that the man is a soldier. But if you know your Army insignia and decorations, you can tell a lot more about him. You know how long he has been in the Army; whether he has served overseas, and where; his rank, pay, and specialized training; his branch of service and the outfit to which he belongs; whether he has been wounded; combat experience and citations for exceptional service. In short, he wears the complete story of his military career on his Eisenhower (battle jacket).

As our veterans come home from distant fronts, you will want to be able to read the language of insignia. It will tell you interesting facts about every service man you see. After studying the insignia worn by Sergeant Welde, see how many of the questions below you can answer. Then turn to the next page. Six correct answers is a good score for a civilian.



**BADGES AND RIBBONS** that Sergeant Welde wears on his left breast are seen in this close-up. The picture at bottom of page shows his right shoulder.

## NOW, CAN YOU ANSWER THESE QUESTIONS?

**1** Did Sergeant Welde enter the service before Pearl Harbor?

**2** Has he served overseas? If so, how long?

**3** In what company, regiment, and division did he serve?

**4** To what command is he now assigned?

**5** What are his rank and monthly pay?

**6** What combat action has he seen, and where?

**7** Was he wounded in action?

**8** Did his unit receive a citation?

**9** Did he distinguish himself while in training?

**10** Did he distinguish himself in combat?

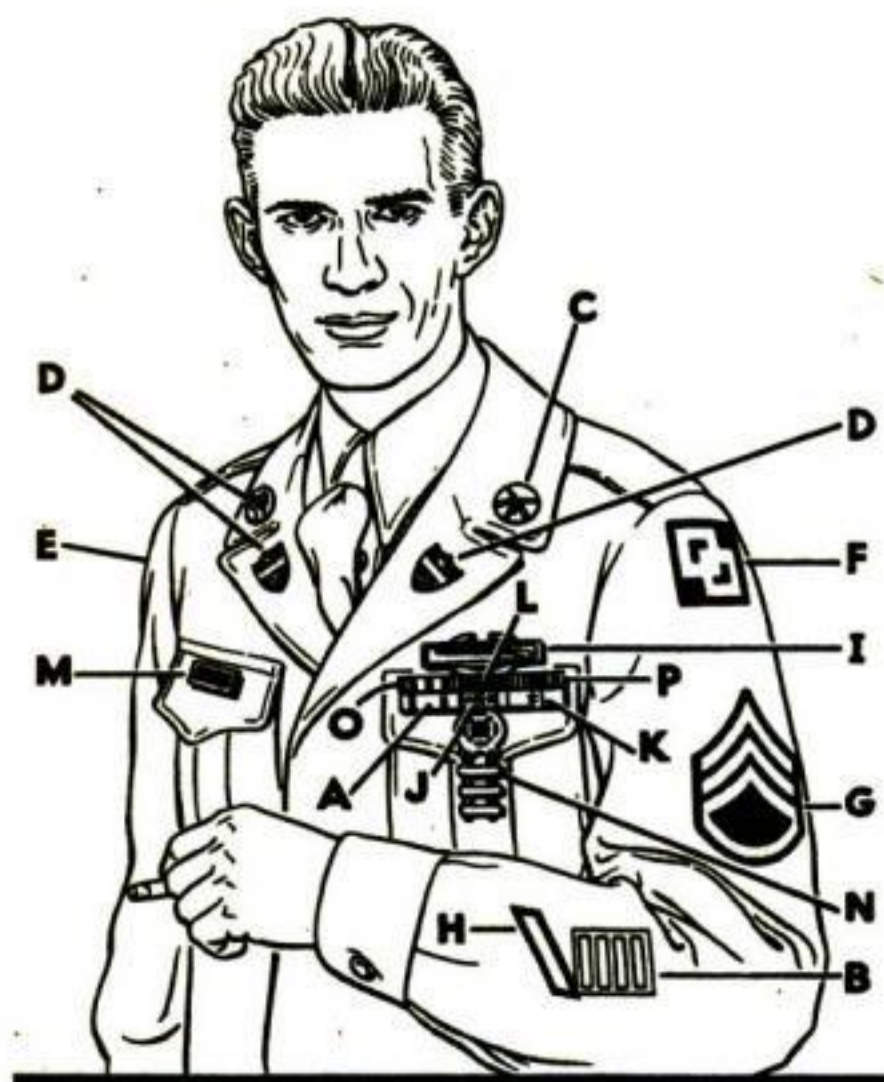
**11** Is he eligible for discharge?

**12** What decorations will he wear when he returns to civilian life?





# ... NOW, CHECK YOUR SCORE ON INSIGNIA



**H**AVE you tried to answer the questions on the preceding page? Here are the facts about Sergeant Welde's military career, as revealed by his insignia and decorations.

1. Sergeant Welde was in the service before Pearl Harbor. He wears the American Defense, or "pre-Pearl Harbor," ribbon (A) at the left in the bottom row of ribbons.

2. The four overseas service stripes (B) on his left sleeve denote at least two years' service abroad. Each stands for six months of overseas service completed.

3. He served in Company F (C), 17th Infantry Regiment (D), Seventh Division (E). This divisional insignia is on his right shoulder because he is not now assigned to that unit.

4. He is now assigned to the Second Service Command (F). Insignia on left shoulder always denotes present assignment.

5. Staff sergeant's stripes (G) indicate base pay of \$96 a month. Hash mark (H), representing at least three years in the enlisted service, adds five percent. Combat Infantry Badge (I) adds \$10 a month. His pay is \$110.80 a month.

6. The Asiatic-Pacific Theater ribbon (J), in the center of the bottom row, stands for service in that theater. The Philippine Liberation ribbon (K), to the right of it, shows service in the Philippines. Stars indicate combat action.

7. The Purple Heart ribbon (L), in the

center of the upper row of ribbons, shows that he was wounded in action.

8. His outfit received a citation, since he wears the Distinguished Unit Badge (M) on his right breast.

9. Expert's Badge (N) under the ribbons shows that he acquired expert skill with rifle and bayonet.

10. He distinguished himself in combat. The Silver Star, represented by ribbon (O) at left of upper row, is awarded for gallantry in action.

11. His insignia and decorations show that he has at least the 85 points now required for discharge. They add up this way: Hash mark, showing he has been in the Army at least three years, gives him a minimum of 36 points. Four overseas stripes give him 24 more points. Add five points each for the Silver Star and Purple Heart, and five points for each of the three stars on the Asiatic-Pacific ribbon. The total is 85 points. (Sergeant Welde actually has 93 points.)

12. On his return to civilian life, Sergeant Welde will be entitled to wear the Honorable Discharge button, or a miniature lapel button representing either the Silver Star or the Purple Heart.

One decoration not listed above is the ribbon (P) of the Good Conduct Medal, which is awarded to men who are recommended for exemplary behavior.

**A**FTER gleaning so much of Sergeant John B. Welde's military career from his insignia and decorations, readers will be interested in a few personal details.

He was born in Norway 25 years ago and became a U. S. citizen when he entered the Army early in 1941. After training in California, he was sent to Attu in the spring of 1943. There he won the Silver Star by being one of three men who wiped out a Japanese antitank-gun crew, killing nine men. His company also won a unit citation on Attu.

After more training in Hawaii, Sergeant Welde landed on Kwajalein, thus winning the right to wear a second star on his Asiatic-Pacific Theater ribbon.

He landed on Leyte on "D plus one" and was wounded nine days later about 10 miles inland. Approaching a foxhole in which he had seen a dead Jap, he was struck in the eye by a fragment of a hand grenade with which another Jap killed himself. This injury cost him the sight of his left eye.

Sergeant Welde is now living at his home in Brooklyn and helping with the Seventh War Loan drive. After his discharge he expects to return to his prewar job as a Diesel engineer on a yacht.



**I'D LIKE TO SEE THEM MAKE...**

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? Popular Science Monthly will pay five dollars for every such suggestion published.

**"VACANT" SIGN FOR TAXICABS,** to tell you whether a car is occupied before it is too late to hail it. It could be an illuminated sign, wired to go off when the flag is lowered on the meter. (Such signs have been used for some time in Washington, D.C., and possibly in other cities.—Ed.)



**REVOLVING-DOOR ARRESTER** would curb those too-peppy people who insist on spinning the door so fast that it clips the heels of more dignified users. It would prevent accidents and anger.

**EVEN-MARGIN TYPEWRITER** that will automatically make all lines come out even at the end. There is now a typewriter that produces this result, but you must first type the page normally and then copy it with adjustments to the machine.



**COIN CHANGER FOR PAY PHONE.** Ever get caught without a nickel when you wanted to make a call in a hurry? Why not have a pay-phone attachment to return nickels for quarters or dimes?

**TRACER GOLF BALL.** We have tracer bullets; why not tracer golf balls? Leaving a trail of smoke, such a ball would show the golfer just where his drive had gone. It would help in finding balls that go off into the rough, and show players what is wrong with their stroke. Fine powder from a reservoir inside the ball might be the answer.







## Model "Compass Rose" Teaches Calibration

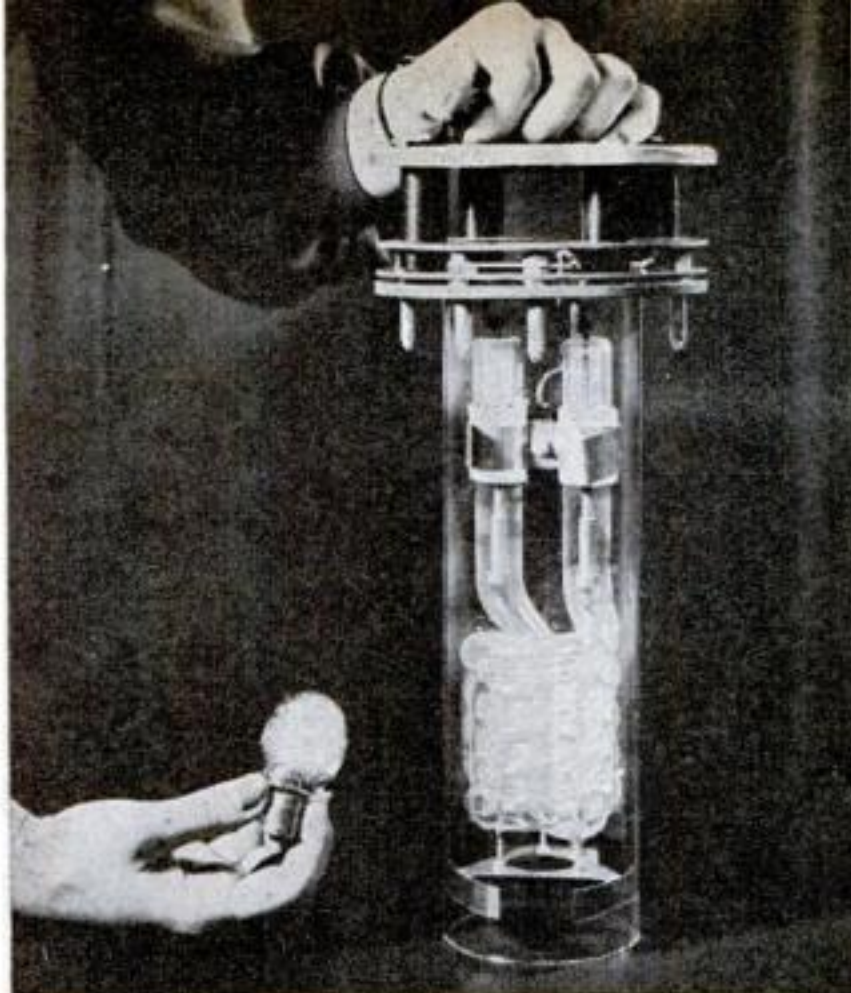
A SMALL, portable copy of the large compass dial painted on Army and Navy airfields is used to teach mechanics compass correction for loaded planes. In the tail of the model Douglas C-54 shown is a magnet, which is swiveled to throw the compass on the fuselage out of adjustment. Students correct the error by rotating the model to the degree indicated by a master compass. The picture was taken at the Army Service School, Santa Monica, Calif.

## "Living Fossil" Dates Back 350,000,000 Years

OFF THE COAST of South Africa, a trawler crew hauled up a strange, bright-blue fish five feet long. The Chicago Natural History Museum, which has the model shown below, says that the group to which it belongs dates back to the Devonian period, some 350,000,000 years ago. It has a double tail, which corresponds to that of fossil relatives; and large, fleshy fins, which, in older species, foreshadowed development of legs for movement on land. Its scientific name is *Latimeria chalumnae*.







This new General Electric repeating flash tube, a million times brighter than the photographic bulb at left, lights up objects from two-mile altitudes.

The repeating flash attached to a B-24 plane throws the Chicago Tribune Tower into approximate daylight for an experiment in color photography after dark. War use included reconnaissance photography.



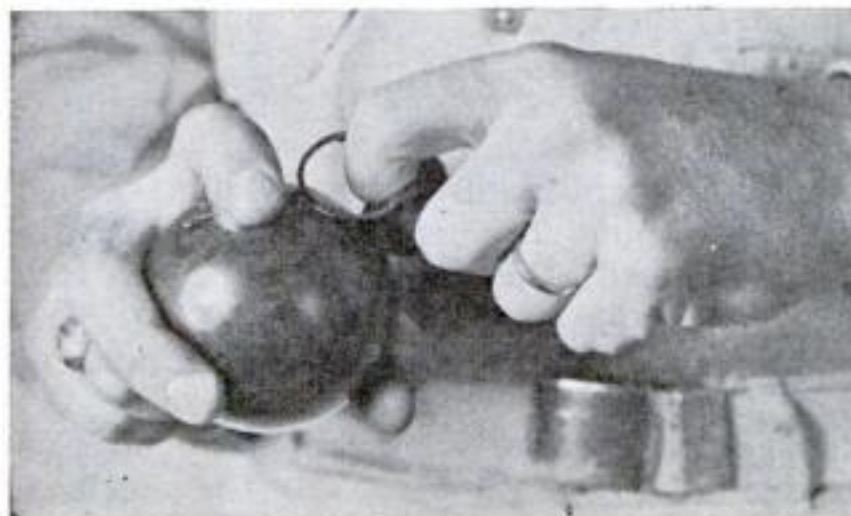
## BRIGHTEST FLASH TUBE MAKES NIGHT COLOR PHOTOS POSSIBLE

WITH the aid of a super flash bulb, the first color photographs to be taken at night from an airplane were shot from a B-24 Liberator bomber recently in Chicago. The plane had a K-19 camera with a 12-inch focal length fixed in the nose. At the tail were two tubelike lights at the center of

30-inch reflectors. The lights were developed by Dr. Harold Edgerton of the Massachusetts Institute of Technology, and are a million times brighter than the ordinary bulb. The flash duration is  $3/100$  second, and it can be spaced at 15-second intervals to make lighting virtually continuous.

## BASEBALL-SHAPED TEAR-GAS GRENADE STRIKES 'EM OUT

DESIGNED by the Chemical Warfare Service especially for the Corps of Military Police, the baseball-type grenade, because of its familiar shape and weight, has proved an accurate weapon in the hands of Yankee hurlers. Thrown like a baseball, the plastic bomb cracks open to release an invisible cloud of chloracetophenone dust that causes weeping but no serious permanent harm to the victims.



Dave Ferriss, Red Sox pitcher, casts a professional eye on the new tear-jerking grenade that is made in the shape and weight of a standard baseball. At the left, a soldier is pulling out the safety pin that arms the bomb before it is sent on its way.





Insignia of the Arctic Search and Rescue Squadron symbolizes its errands of mercy in the frozen north.

Sled dogs board a Douglas C-54 cargo plane to be flown to an advance base where they are needed. If the plane can't land at their destination, the huskies will hit the silk. Most of the dogs like flying; they curl up and sleep aboard the plane.



# Men, Dogs, and Machines

## SAVE FLYERS WHO CRASH IN THE ARCTIC



**THE AUTHOR:** C. B. Colby, aviation editor of *Popular Science Monthly*, rides a pulka at an ASR base in Newfoundland. This shovel-like sled, made of molded plywood with flat steel runners, can carry an injured man or 500 pounds of cargo. Pulled by one dog, it passes easily through underbrush that would entangle a larger sled and team. Pulka-pulling dogs fall into line as their names are called, then follow their leader as he picks a path across country.

THE crew of the PBY patrol plane were hopelessly lost. They hadn't the faintest idea as to their exact location over the wilds of Greenland close to the Arctic Circle. They checked their air speed, their altitude, and their compass. They looked at each other with that half-amused, half-puzzled look that men have when they are completely baffled and not quite scared—yet. Everything seemed to be in order about the plane, but there was a peculiar feeling of steadiness about their flight. Outside the frosted windows there was nothing but blinding snow in all directions.

Suddenly one of the men got an inspiration. He forced open the door of the plane and peered down into the swirling snow. For a moment he hesitated, then calmly stepped out of the plane—apparently into open space.

The rest of the crew watched with bulging eyes. They saw him run alongside to the front of the plane, where he stopped and signaled for the pilot to kill the engines.





Trying to find a crashed plane in northern wilds often is like looking for the proverbial needle in a haystack. In this photo, the circle marks all that is visible from the air of a Canadian plane that was wrecked in Labrador. Eleven men marooned in this crash were brought out by helicopter. At right: Search and Rescue crew at Harmon Field, Newfoundland, commanded by Major George Barnes.



Speechless, the pilot did so, and the man ran back and climbed into the hull to tell his astonished companions that they had been sitting on the ground in a snowbank with the engines wide open. They had slid up the gradual slope of a snow-covered mountain and stopped, still apparently several thousand feet in the air and going along at normal speed. To this day, they don't know how long they "flew" on the ground.

Usually crash landings in the arctic are another and more tragic matter. That is why the Arctic Search and Rescue Squadron of the North Atlantic Division of the Air Transport Command was formed. The members of this rugged organization say they can get a man out of almost any predicament. Their record of almost 100-percent recovery of personnel, alive or dead, since the formation of the unit in 1943, backs them up.

As soon as the North Atlantic Division of the Air Transport Command had demonstrated that they could fly the North At-

lantic around the calendar, as well as around the clock, it became evident that they needed not only the regular air-sea rescue service already in action, but additional protection for men and planes down over land. This must be a service capable of covering millions of square miles of wilderness up to and above the Arctic Circle. At that time, the only means of rescue were hit-and-miss, the use of trappers, traders, natives, and hastily organized groups of volunteers.

Realizing the need for quick rescue in the stunning cold of the arctic, Lt. Col. Norman D. Vaughn, then in command of the ATC base at Goose Bay, Labrador, suggested that perhaps the solution might be dog sleds and trained rescue personnel maintained at permanent bases ready for instant action. The Colonel had already proved the value of dog sleds on the Greenland ice cap when he had taken part in the salvage of tactical aircraft forced down on the way to Europe. He was put at the head of the unhatched Arctic Search and Rescue Squadron





These huskies will pull twice their own weight all day and still be full of pep at nightfall. But they're smart enough to rest when they can.



In a flying suit and parachute harness, this Saint Bernard is ready to hit the silk for a rescue. Many of the dogs seem to enjoy jumping.

How a nine-dog team looks from the sled. Drivers don't say "Mush!"; it's "All right, let's go!" One of the dogs up front has got on the wrong side of the rope.

of the ATC's North Atlantic Division, with orders to establish bases and obtain and train the required personnel.

Army personnel records were scanned for men with arctic experience, ski experience, dog-sled experience, and any other backgrounds that might fit into the picture.

Whenever a suitable man was located, he was transferred to the about-to-be-born unit, and others not yet in the service were contacted and urged to enlist. These included trappers, traders, and explorers; guides, and members of former arctic or antarctic expeditions. Every man had some peculiar qualification for this job.

The unit maintains contact with about 20 bases where planes can be landed, and with dozens of tiny weather stations scattered over northern Maine, Labrador, Baffin Island, Newfoundland, and Iceland. Many of these weather stations are serviced only once a year when planes can land near by on flight strips carved out of the arctic waste. The rest of the year they are supplied by parachute.

Marooned flyers make themselves comfortable with gear dropped by 'chute while they wait for the rescue party. They have built a shelter of blocks of snow to shield them from the wind.





An injured airman on a dog sled is lowered over a cliff on the way out of the wilderness. The dogs of the search party were brought down in the same manner.

For lack of emergency landing fields across the North Atlantic route, the dog sleds and other special equipment are kept at key emergency bases from which they can be flown into areas where planes are reported down.

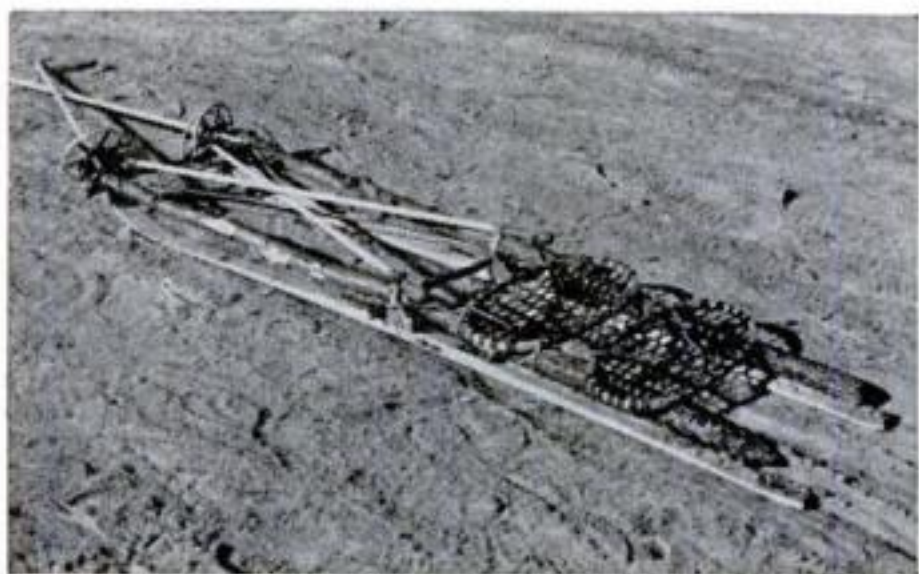
The first duty of the rescue service is to locate the lost plane and then fly in medical aid and cold-weather equipment. The weather stations help find the downed ship; if its radio equipment can be operated, it is only a matter of a few hours until the ASR planes are overhead dropping emergency equipment. If radio directions are impossible, signal panels are displayed by the crew members to inform the search planes of conditions at the crash. (P.S.M., April '44, p. 100.)

All necessary supplies can be dropped to survivors by parachute, and the doctors of



the service go right along too, via the silk. If the wreck is too far inland to be reached by sleds and dogs from a near-by base, they are flown to the area and dropped on 'chutes for the long trek out with the injured. Most of the dogs "hit the silk" with nonchalance.

Skilled in the use of special arctic medi-



Skis, bear-paw snowshoes, and ski poles make an improvised sled for bringing out a helpless man or parts salvaged from the plane. One pair of ski poles serves as braces; another, for pulling sled.

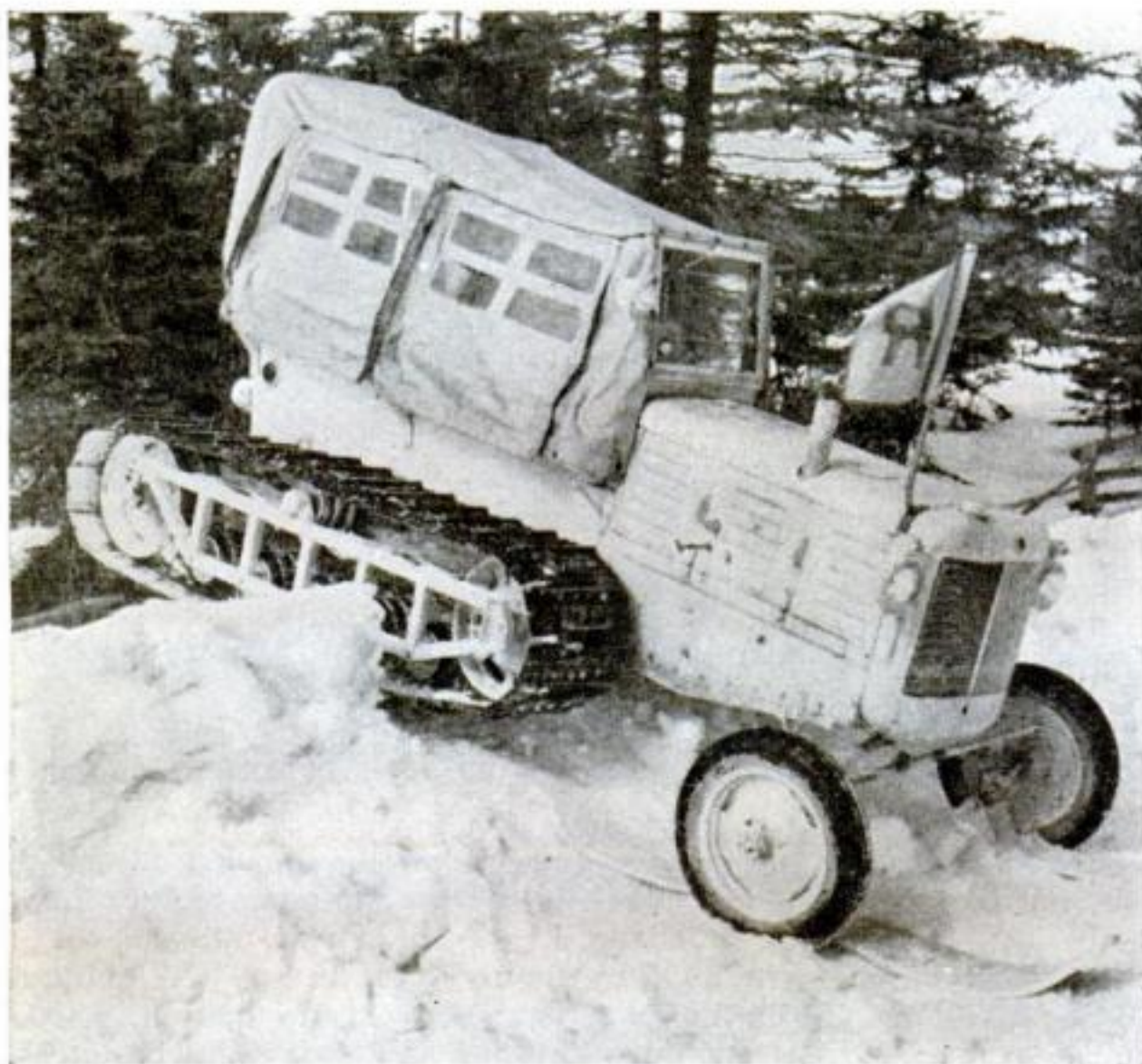


This cargo sled has a flooring of wooden slats bound to the runners with a continuous rawhide thong. The resulting flexibility allows the runners to follow uneven ground. Runners are "greased" with iced moss.

With a saddle pack, a Saint Bernard can carry 50 pounds. Every fifth dog on a rescue trip carries food for himself and four others. Saint Bernards are quarrelsome and touchy; handlers prefer the huskies, which are friendly and willing workers. Sleds seen in the background are of the cargo type used for hauling supplies and salvage.





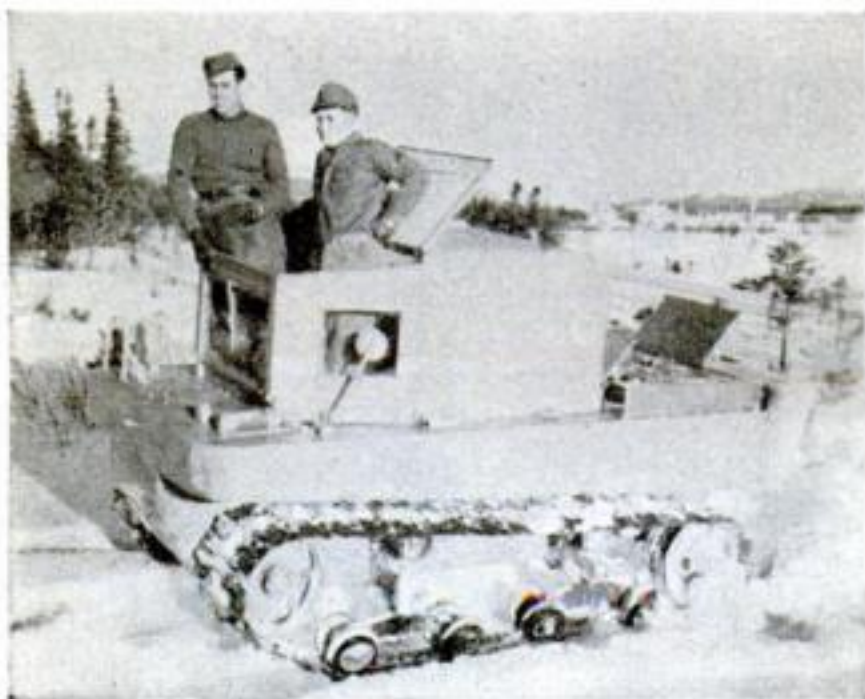


**HELICOPTER** to the rescue: a Coast Guard "wind-mill" alights on a frozen lake with one of the 11 Canadian airmen marooned in the crash shown on page 123. Flown dismantled from New York in a cargo plane, it was assembled and picked up the survivors one at a time on a dangling rope ladder to carry them to safety.

**TRACTOR.** This M-7 can pull from one to four litter trailers like the one seen at left, below. Its tread pressure is only  $\frac{3}{4}$  pound per square inch—less than the weight of a man. With skis on the front axle, it can travel on soft snow. The trailer is fitted with lights and heater.



**WEASEL** amphibian is painted bright orange for rescue work, so it can be spotted from the air. It makes fair speed in water with paddles on treads.



cal kits, the doctors of the unit are also trained in the use of parachutes, although only a few have had occasion to use them in bringing aid to AAF personnel. Of those who have, Lt. Col. Daniel H. Maunz, who has twice performed appendectomies under trying circumstances, is an outstanding example.

His first unusual operation was late in 1943, upon a cook for a group of scientists studying weather conditions somewhere on Baffin Island, beyond the Arctic Circle. An appeal for aid for this man was relayed to a base of the North Atlantic Division late in 1943. The base surgeon made a diagnosis by radio and decided that there was no time to lose.

Flight Surgeons Maunz and Yearwood volunteered to fly to the aid of the man, with the understanding that, if the plane was unable to land, they would parachute to the ground ready to operate. Experienced parachute men went along to give them last-minute instructions.

When they arrived over the tiny base, it was obvious that a landing was impossible. Undaunted, the two doctors prepared to bail out with their medical kits. Just before Captain Yearwood was ready to jump, his 'chute fouled, and it was hurriedly decided that Colonel Maunz would jump alone. Neither of the two men had ever used a 'chute before, but out the Colonel went, counted calmly to seven, and yanked the rip cord. When he landed, jarred but un-





hurt, he was surrounded by the personnel of the base and all the Eskimos living in the area.

The operation was a success, and three weeks later the cook was back on the job—a job, incidentally, taken over by the doctor in the meantime. An ironic touch to the rescue and operation was the fact that, in attempting to build a snowmobile with an old engine found at the base, Colonel Maunz let it fall on him and broke a leg. He had to set his own leg and wait 11 days for his own rescue. The intervening time was spent giving medical aid to the Eskimos and teaching first aid to the base crew. Colonel Maunz received the Soldier's Medal for this mission.

Maintaining radio contact is of paramount importance. Before the crash, if possible, the radio operator sends out his approximate location and any other data that might aid the rescuers. After the crash, he sends additional data if the condition of the operator and equipment permits.

When it is known at headquarters that a plane is going down or has crashed, a search is at once organized with all

units co-operating. The time element is all-important. With the approximate location of the crash established, the search planes take off, flying a grid pattern over the area. Often the natives give invaluable aid with reports of finding wreckage, hearing a plane in distress, and noticing sudden explosions or fires. *(Continued on page 208)*

**EXPOSURE SUITS** protect flyers from the shock of falling into cold water. Shown below under test, these AAF suits can be put on quickly in an emergency. They hold enough air to keep afloat.





This French stamp, issued in 1936, was once available at a dollar. Today it would cost \$25.



# Fortunes in Air-Mail Stamps

Collecting is not only a fascinating hobby . . . It's a good investment —if you select wisely.

By **HENRY W. ROBERTS**

Photographs by **WILLIAM W. MORRIS**

SIXTEEN years ago, in 1929, you could have bought all the air-mail stamps then in existence for about \$5,000. Six years ago the catalogue value of those same stamps was more than \$20,000. Today, they are worth almost \$30,000. A complete collection of all the air-mail stamps of the world, including those issued and discovered since 1929, would be worth approximately \$150,000.

Until the late 1920's, air-mail stamps were the orphans of philately. Most stamp collectors regarded them as freaks. Then, in 1927, Lindbergh flew across the Atlantic, and the world awoke to the possibilities of air transportation—and air-mail stamp collecting.

Even today, collecting air-mail stamps is a new hobby. Every year, in addition to new issues being regularly printed by various recognized governments all over the world, fascinating discoveries of heretofore little-known, little-used air-mail stamps are being made. For example, last year there was discovered a series of 16 air-mail stamps issued in 1923 by the short-lived Far

Eastern Republic, originally established under Kolchak in Vladivostok in 1920 and now absorbed by the U.S.S.R. A complete set of these 16 stamps today is worth \$1,510, used or unused.

Stamp collecting is not only a fascinating hobby, but also a safe and profitable means of investment—provided you know what you are buying, and why you are buying it.

Generally, stamps double in value once every 10 years—on an average. Remember that phrase, "on an average." At the end of 10 years, a typical collection of a hundred air-mail stamps will show no increase in value for about one half of them, only a nominal increase for about 40 percent, a decrease for one or two stamps, a hundred-fold increase for five or six stamps, and a thousandfold increase for the odd stamp or two.

The best bet in collecting stamps as an investment is to buy rare ones. Skip the ordinary stamps, however pleasing to the eye. Just think of the time, in 1928, when two ugly-looking French stamps, overprinted for experimental air mail carried from the French liner *Ile de France*, could be bought for less than \$20; they are worth \$200 for the pair today. Consider the ob-



# \$51,800—TEN MOST VALUABLE AIR-MAIL STAMPS IN THE WORLD!



## THE FIRST TIME IN HISTORY...

the 10 rarest and highest-priced air-mail stamps have been photographed on a single plate. Photography was done in Popular Science studio with the co-operation of Nicolas Sanabria, air-mail stamp expert.

VALUE \$3,000, but highest price ever paid for a single copy was \$4,250.



\$2,000 worth of stamp is the 1924 Bolivia 10-centavo with inverted center.



\$15,000 is the price of the famous "Black Honduras," costliest of air-mails.



\$3,000 is what the inverted Bolivia 1924, two bolivianos, is valued at.



\$2,250. A couple of these Newfoundland, 1919, "Hawkers" would buy a home.



\$6,000. A color error in this Gen. Balbo Newfoundland stamp made value.



\$3,750 is the value of the Newfoundland De Pinedo commemorative stamp.



\$2,750. This rarity was issued by China's offices in Sinkiang province.



\$2,800. Mistake in color gave additional value to this Mexican stamp.



\$10,000. "Red Honduras," second most costly of all the air-mail stamps.



scure Kuwait four-anna stamp of 1934 that was sent "on approval" to collectors for a dime and is now worth \$35! There must be at least a couple of hundred such examples.

Whatever you decide to collect, make an intelligent selection. An average man today cannot hope to accumulate all the air-mail stamps, especially if he attempts to include the high-priced "errors." Try to make a complete collection of some highly specialized stamps, and let them reflect *your* tastes, *your* preferences.

For example, you might start collecting only triangular air-mail stamps. Or you might specialize in the stamps of a single country. (Bear in mind that most of the South American stamps are still underpriced.) Most stamps are printed in only one color, but a great many are in two; these are called bicolor stamps. A few are printed in more than two colors; these are designated as multicolor. A thoroughly interesting and rather inexpensive collection can be started by specializing on one kind.

I know a man who is collecting stamps that picture airplanes. There are thousands of such stamps, depicting hundreds of types of aircraft. Some people collect only overprinted stamps. Some make collections of only the Zeppelins, which are often quite expensive. Others collect only "errors." To the last-named class belongs one of the rarest air-mail stamps in existence.

On May 14, 1918, W. T. Robey, an employee of the Riggs Bank in Washington, D.C., went to the nearest post office, stood in line at the window, and bought a complete sheet of 100 of the new 24-cent air-mail stamps. The postal clerk collected \$24—and handed

Robey a small fortune. The blue airplane in the center of each of those stamps was printed upside down!

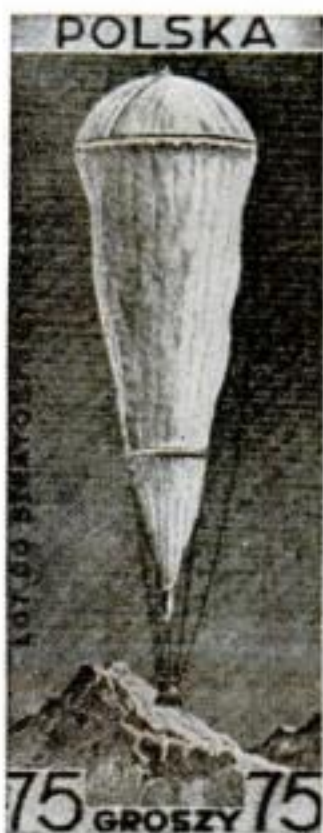
A week later Mr. Robey sold his sheet of stamps for \$15,000 to three Philadelphians: Percy McGraw Mann, Joseph Steinmetz, and Eugene Klein. A few days afterward, the three-man Philadelphia syndicate sold the sheet to the late Col. E. H. R. Green for \$20,000. Today those 100 stamps have a total market value of more than \$250,000. The highest price ever fetched by a single stamp of this kind was \$4,250!

The reason for the high price is that the U. S. Bureau of Printing and Engraving never makes a mistake—well, hardly ever. As soon as the existence of Robey's sheet became known, an official search disclosed that several other sheets were printed wrong. These were immediately destroyed, and Robey, the only owner of such a sheet, was invited to come in and have his sheet of stamps destroyed too. He politely declined.

What makes a stamp valuable is its rarity. What makes a stamp expensive is the demand for it among collectors. For example, the ten costliest air-mail stamps in the world, illustrated on page 129, are now worth \$51,800. A dozen years ago you could have bought them all for less than \$2,000. As originally issued, they added up to less than \$10!

There is a fascinating story behind every rare air-mail stamp, with something of history, something of adventure, something of treasure hunting. You have just read about the U. S. 24-cent invert. Now read about the other nine most valuable air-mail stamps.

Absolute tops in price is the "Black Hon-



Polish 1938 stratosphere flight is tallest air-mail.

## LEADING AUTHORITY ON AIR-MAIL STAMPS



NICOLAS Sanabria came to the United States from Venezuela in 1922 with two assets: his stamp collection and his knowledge of what it held. He went into the stamp business, and specialized in air-mails. Foreseeing the need for an air-post catalogue, he issued one in 1936. This has grown until today it runs to 1,000 pages, and has become a standard. Stamps shown here are from Sanabria's safes.







Rumanian midget is smallest air-mail; Nicaraguan giant is largest.

Zeppelin stamp issued by Russia in 1930.



Spanish Red Cross air-mail stamp.

One of the Greek mythology series.

Italian Zeppelin stamp of 1933.

Stamps shown on this page illustrate the wide variety in the design, shape and size of air-mail stamps.

duras." In 1925, American aviator T. C. Pounds established Central American Airlines, flying the 145-mile run between Tegucigalpa and Puerto Cortez, in Honduras. The company's only "airliner," a decrepit single-engined plane, was flown by pilot Morgan, of Buffalo, N. Y. A few of the

regular 1915-1916 Honduras stamps were overprinted locally *Aero Correo* on a small hand press by another American, Karl Snow, under the authority of the Postmaster General of Honduras, and were used for a year or two on the infrequent air-mail letters carried. *(Continued on page 205)*



Eagle issue, Liechtenstein, 1934-1935

Some collectors go for triangles.

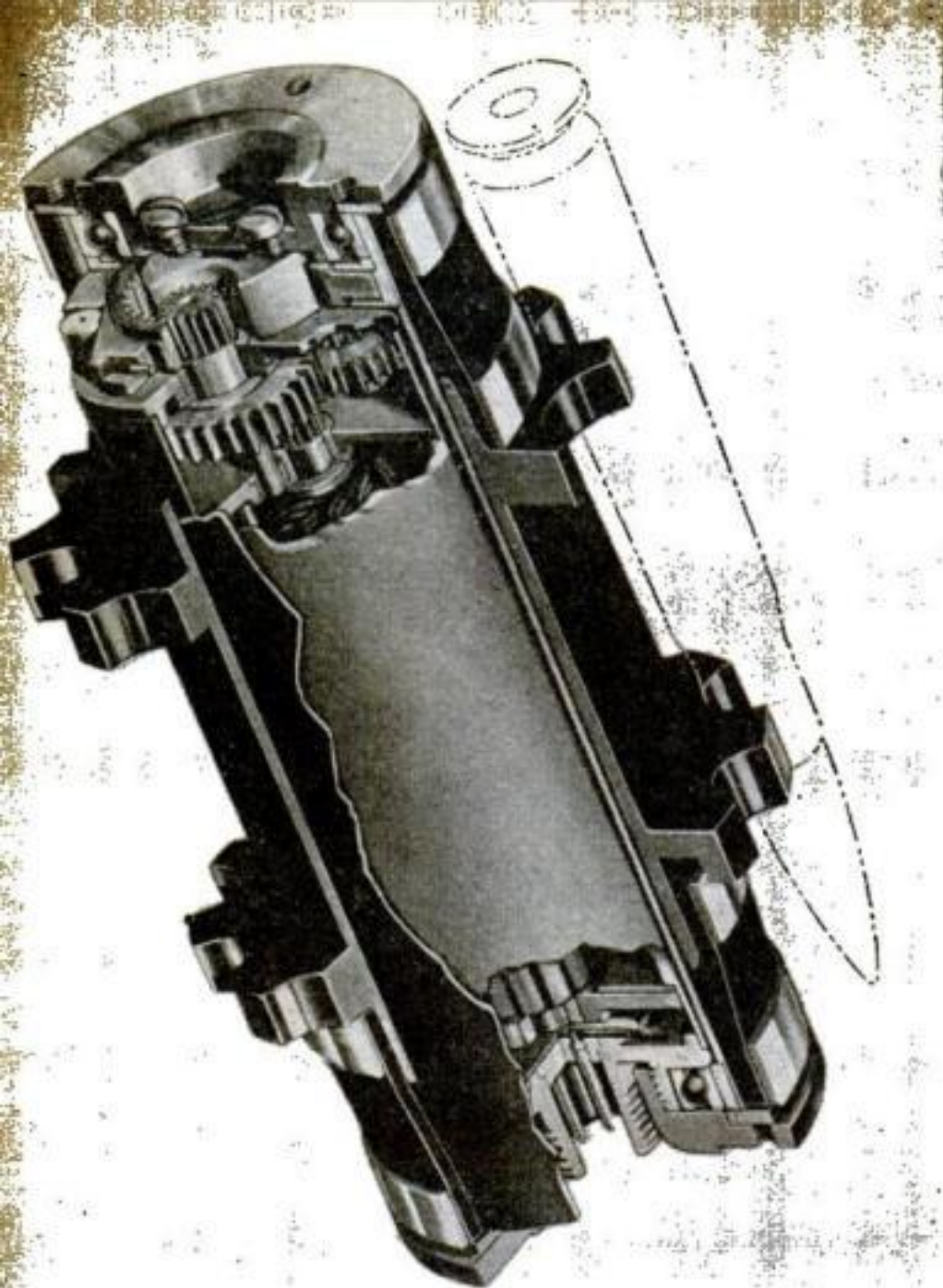
This is one of the low-priced stamps.



One of a set of bicolor Persian stamps.

Two of Italy's former North African colonies are represented here.





This is how a heavy-duty booster, with its housing removed, would speed 20-mm. shells through stainless steel chuting and into a plane's cannon. Cut-away (left) shows the reduction gears that enable the tiny 1/10-hp. motor to turn the two sprockets, feeding ammunition as fast as the gun can fire it.

A four-gun chute installation like this is adapted for either turret or fixed guns. Some chutes are 20 feet long, leading to ammunition containers in remote parts of a plane. In such cases, two boosters are used, pushing and pulling simultaneously, to ease the flow of the long "ammo" belt to the gun. ➔

## *Now It Can Be Told* **Forced Feeding of**

By **ANDREW R. BOONE**

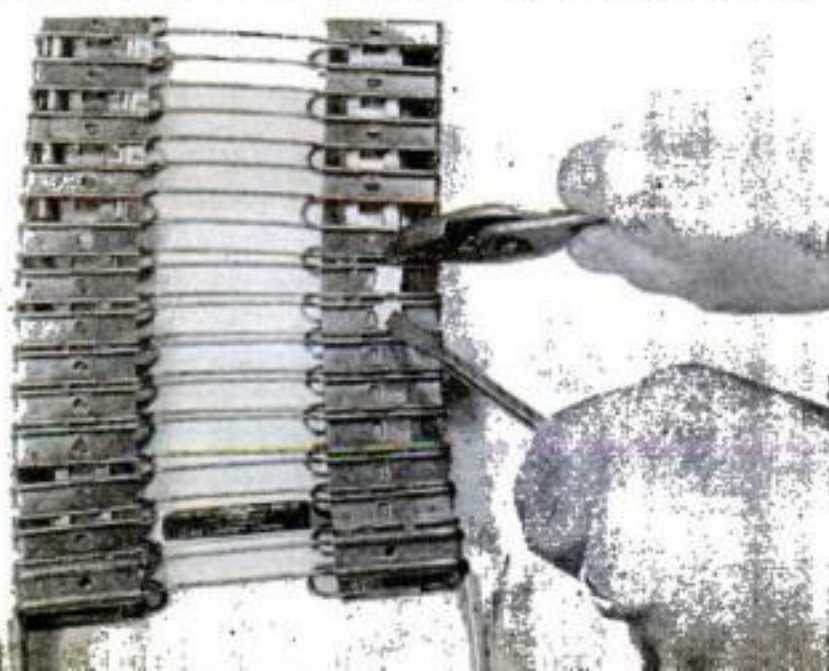
**T**HE wraps have been taken off two clever but simple devices that speed ammunition into airplane guns as fast and as surely as the weapons can pour it out. Developed by engineers of the Hughes Aircraft Company, Culver City, Calif., they consist of flexible, stainless-steel chuting and a tiny, freewheel-

ing electrical gadget called a booster. Together, they smooth the flow of shells, from .50 caliber to 37 millimeter, into machine guns and cannon, feeding the "fifties" at the rate of 1,000 rounds a minute.

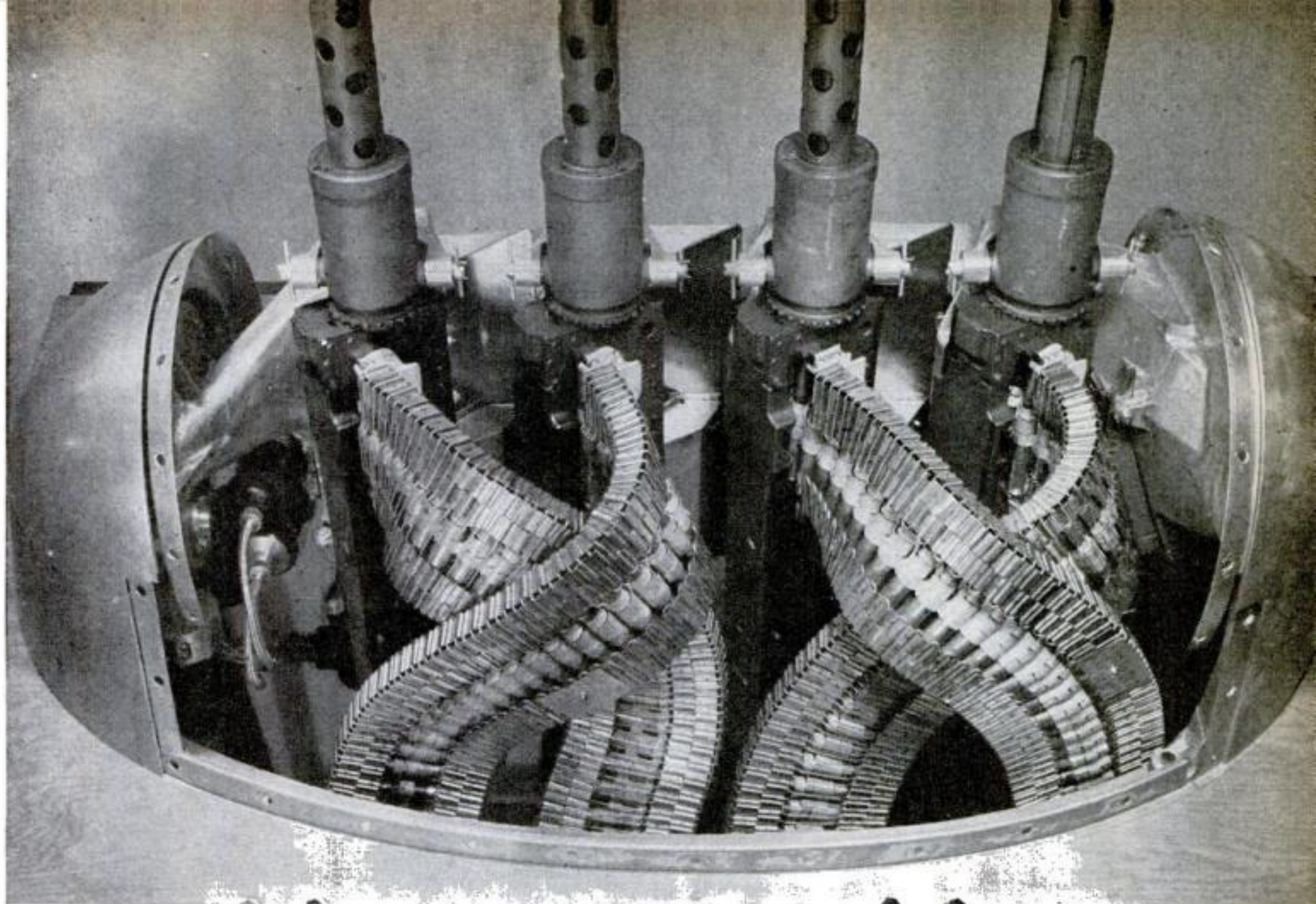
The chuting is a series of interlocking links, whose interiors fit the form of the cartridges and which are so joined as to form two narrow tracks of smooth, stain-



**CHUTES** may be bent sideways around a 12-inch radius (left) and twisted 90 degrees within one foot of their extended length (lower left) without snagging the ammunition that is being pushed or pulled through them. As a free gun twists and turns, the chuting may weave like a snake, but it won't come apart unless it gets a direct hit. Simple tools disengage links for repair or shortening the line.







# Guns Boosts Plane Firepower

less steel at each end of the cartridges. Fully extended, the chute contains 14 links per foot, and it can be compressed, twisted, and turned without snagging the shells being channeled through it.

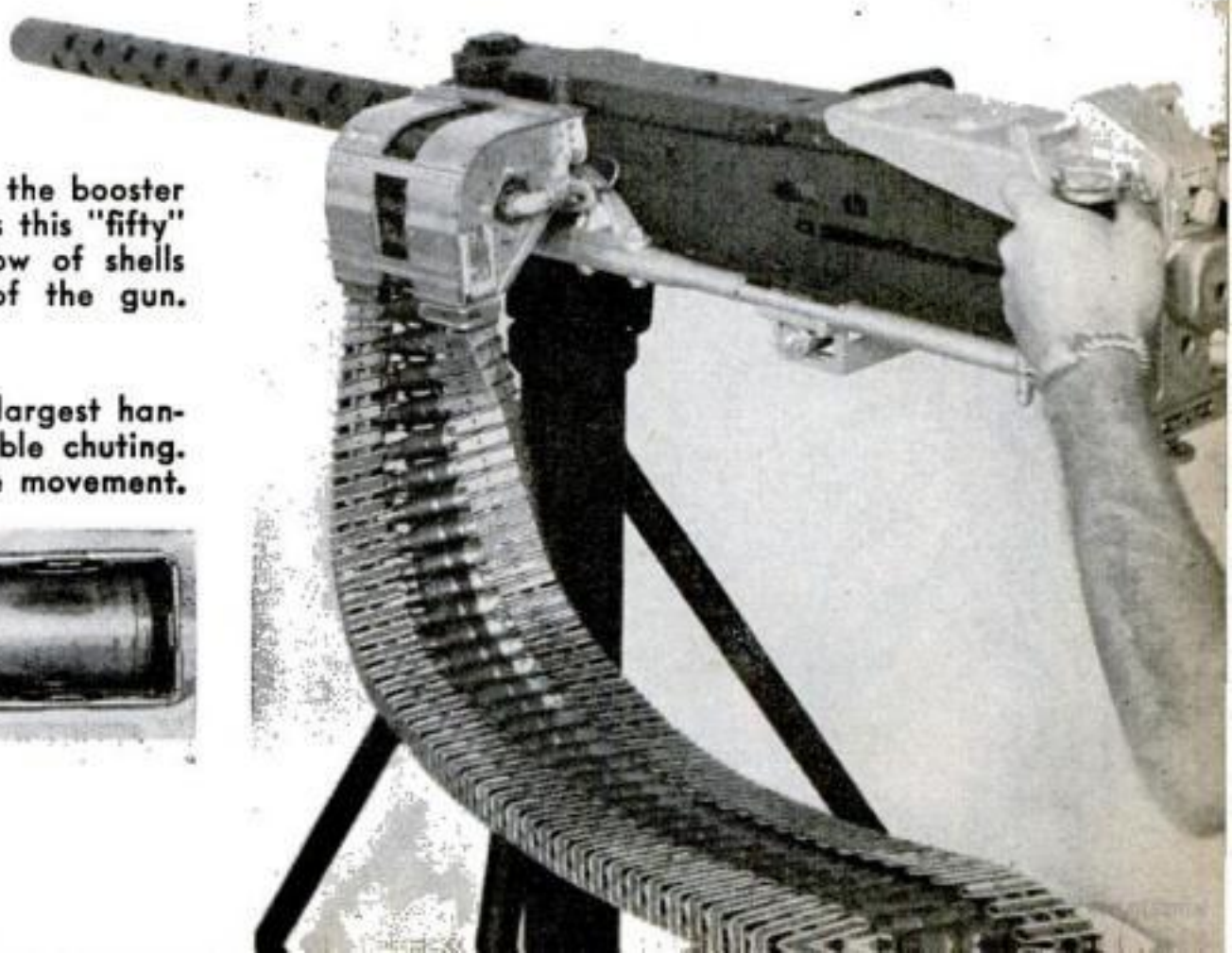
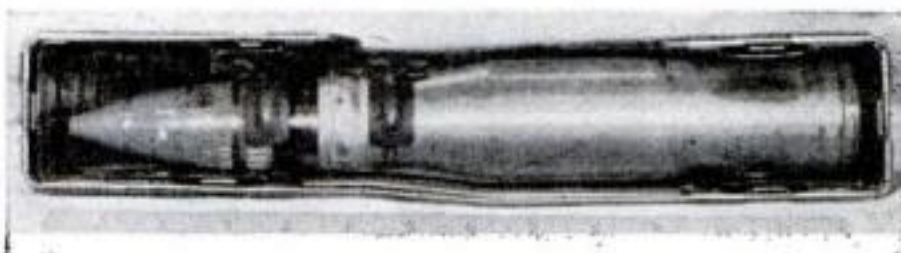
The booster, which weighs one pound, 11 ounces, has two integral sprockets that are revolved through reduction gears by a 1/10-hp., direct-current, 10,000-r.p.m. motor. Con-

nected in conformity with the gun-firing circuit, the booster turns on its power when the gunner hits the trigger and moves the ammunition forward at a rate equal to the cyclic rate of the gun.

The shortest chute to see service connected an ammunition box to a gun through only three links. The longest, 280 links, fed "ammo" to a weapon in a big bomber.

Attached to a gun by special adapters, the booster pulls the ammunition forward as fast as this "fifty" can spit it out. The smooth, rapid flow of shells results in less jerking and weaving of the gun.

A 37-mm. cannon shell (below) is the largest handled by the power booster in the flexible chuting. Its snug fit in the housing prevents side movement.





# ODD FACTS

**M**ODERN Americans do not hear as well as their pioneer ancestors did, according to scientists of Sonotone Research Laboratories, who say that one out of 10 adults in the United States is handicapped by defective hearing.

The ear is like a radio microphone. Con-



**SHE'S DEAF, BUT—** the gossips who are whispering don't realize that Grandma has learned lip reading and can understand their whole conversation. So, in spite of her handicap, the old lady is getting an earful of dirt.

**SOUND GETS A MOVE ON** when it travels through iron. Its normal speed through air is 1,087 feet a second, but it goes 15 times as fast through iron. Glass is an even better conductor of sound; through it the vibrations travel at 18,000 feet per second.



**ANIMALS' EARS ARE ALERT** to some sounds so high-pitched that human beings cannot hear them. A dog whistle, silent to the user but audible to the animal, takes advantage of this fact. The range of human hearing embraces sounds with vibrations between 20 and 20,000 per second, which have been determined as the limits for approximately perfect ears.



**BARITONE NOISES LAST LONGER.** It has been discovered that low-pitched sounds traveling through the air do not fade out as quickly as noises with a higher frequency of vibration. An example is thunder that follows near-by lightning—a quick, sharp crash. At a distance it becomes a low, heavy rumble extending over a much greater period of time.



# ABOUT EARS

nect the auditory nerve of a rabbit to an amplifier and loudspeaker, and whisper into the ear; you can hear the words from the loudspeaker.

Pictures on these pages illustrate some of the curious facts revealed by research into sound and the way it affects us.



**A HORSE DOESN'T CUP HIS EARS.** He doesn't have to, for he can waggle them around to pick up the sound waves from whatever direction they may be coming. The human external ear is, from our view-

point at least, better looking, but it is not as efficient in collecting sounds from all directions. It is common knowledge that horses often shy at noises that are unheard by their drivers or riders.



## WHAT SOUNDS GOOD

to one man may give another the willies. No two persons hear exactly alike; your audiogram (a chart

showing the relation of frequency to audibility in your particular case) is as individual as your fingerprint. Many of us have defective hearing for certain tones, though we may not be aware of it.

## WHY DO COCKS CROW SO LOUD?

As far as decibels go, the sound isn't unusually loud. It just strikes city people that way when they visit the folks down on the farm. With no blanketing street roar to dampen the sound, the noise of the rooster seems terrific.





## What's New in Modern Living

**A BUILT-IN BLACKBOARD** is the feature of this swing-top study table. The convertible desk, manufactured by the Lewyt Corp., of Brooklyn, N. Y., is intended for children from three to nine years old.



**THERMOSTATIC CONTROL** for glass cooking ware has been a thorny problem for appliance engineers because the thermal conductivity of glass, being about one tenth that of metal, makes ordinary thermostats impractical. General Electric, putting its powerful alnico magnets to work on the question, has come up with the coffee maker shown above. As the water rises, it lifts a metal armature inside the bowl, disengaging a magnet. Falling, this operates a switch.



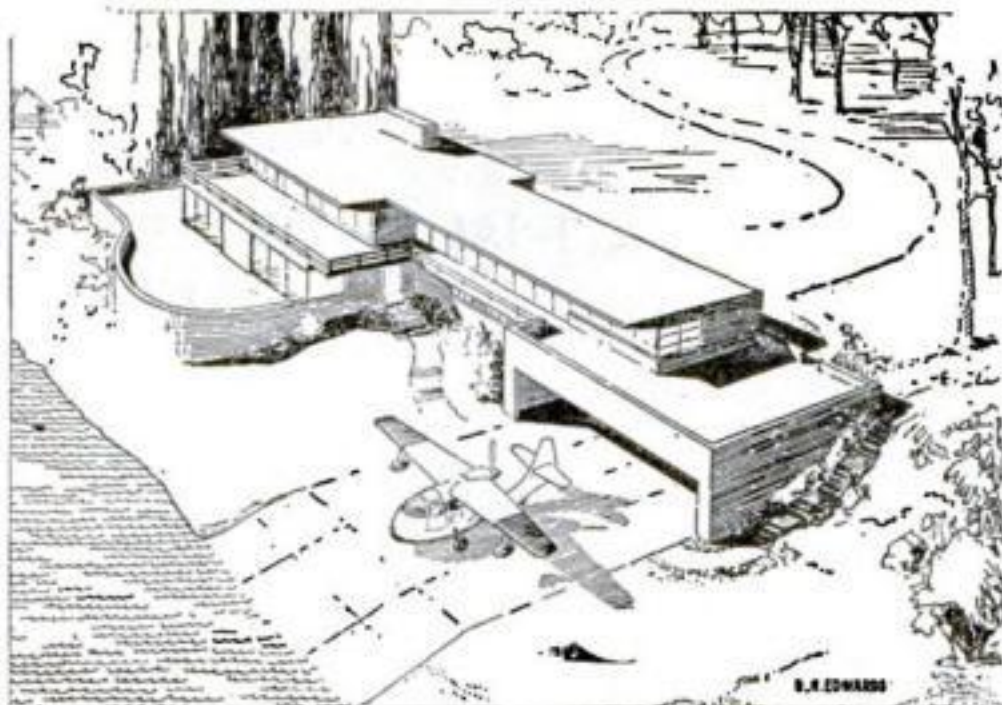
**FIBER FLARES**, developed by the Kindle-Lite Corp., of Brooklyn, N. Y., for the Army Air Forces, are used by paratroopers for emergency light and heat. The chemically impregnated, phosphorus-tipped blocks can be ignited by striking and will burn even when floating on water.

**PAINLESS BUDGETING** is the general idea behind the purse pictured below. Four compartments, each headed by a removable tab, make it possible to allocate cash to the different items of expense when funds are received. By making purchases from the right pocket, figuring is eliminated. It is made by Budget Pocketbooks, Cleveland.



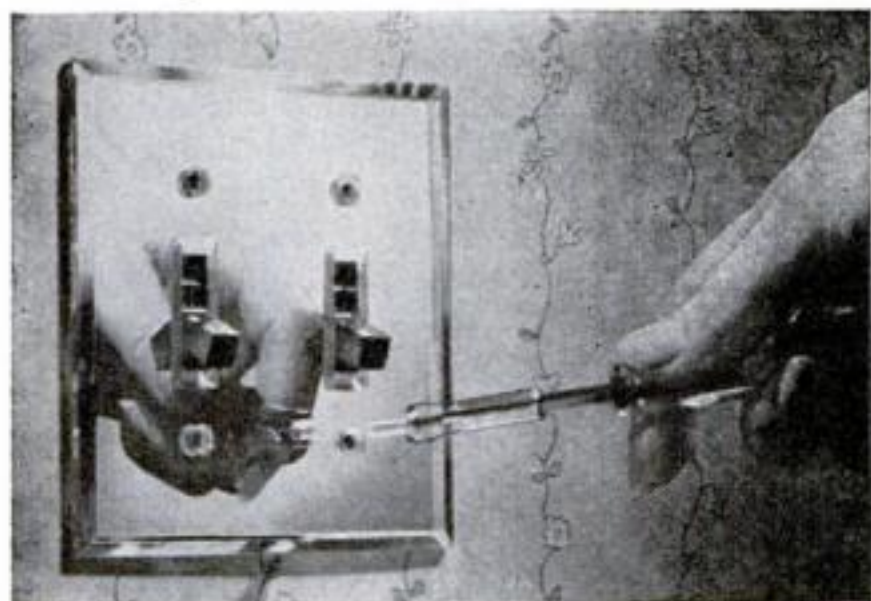
**WATER SPORTS** are rendered safer for children and adults alike by this flexible life vest made by the American Pad & Textile Co., of Greenfield, Ohio. The jacket is designed to allow freedom of body movement so that it can be worn continuously in the water.





**ATTACHED HANGARS** for family planes are envisioned by engineers at the Republic Aviation Corporation, of Farmingdale, N. Y., as part of many homes of the future. With the coming of peace, Republic plans to produce a private plane that will offer a choice of land or water take-off and landing. The owner of such a plane would find it advantageous to locate his home beside a lake.

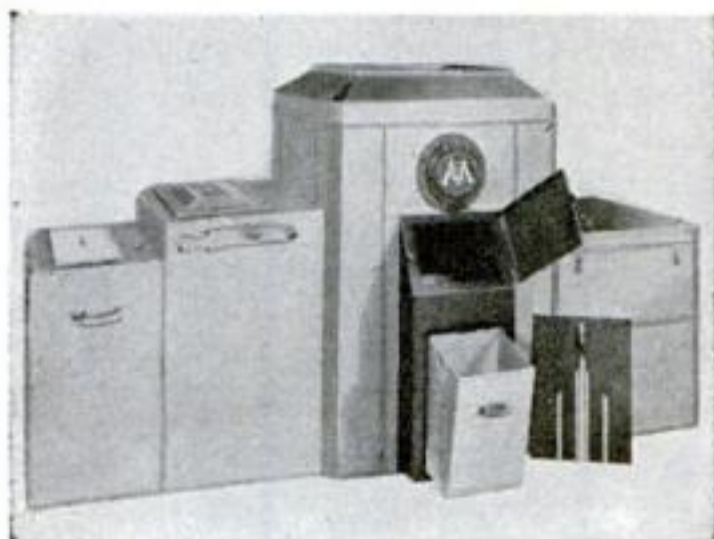
**FURNACE TENDING** eventually may become a job of the past in the homes of Chisholm, Minn. Municipal officials there have approved a postwar project for construction of a central heating plant to furnish live steam to every dwelling and other building in the community of 7,500 persons. Proponents of the plan declare that new homes should cost less because neither furnace nor cellar will be required. The city itself also hopes to save money through elimination of ash collection.



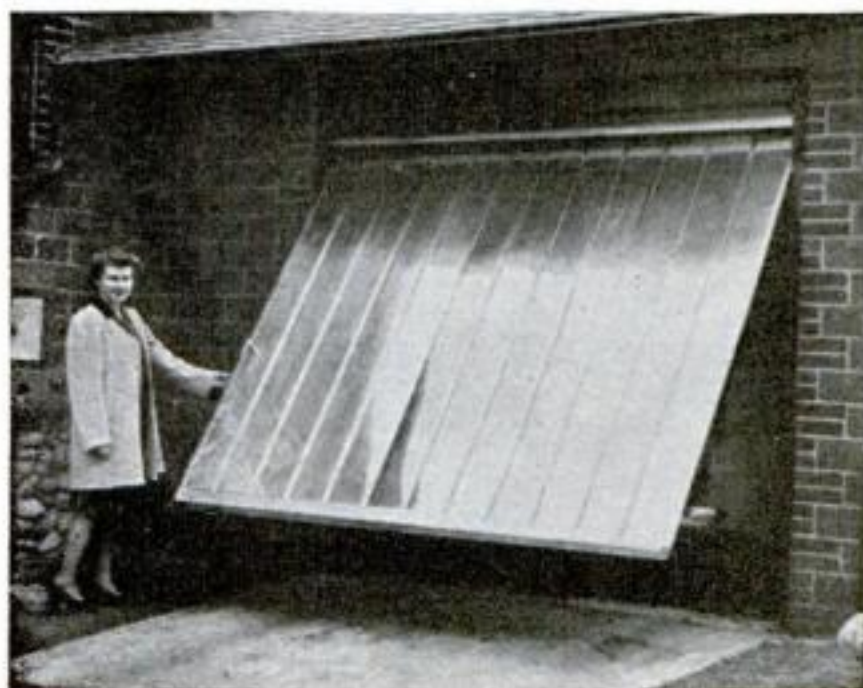
**PLASTIC SCREWS** are being manufactured by the S. S. White Plastics Division, of New York City, for attaching mirrored switch plates. Injection-molded of transparent plastic, they improve the appearance of the plates and cause less breakage during installation than metal screws. Now made in only one size—6-32,  $\frac{1}{2}$ " long with an oval head—the screws eventually will be molded in lengths from  $\frac{1}{4}$ " to 1" with various heads.



**CLINKERS** that collect in stoker furnaces ordinarily must be clawed from the fire box with a poker, permitting fine fly ash to escape into the basement. The Majestic Company, of Huntington, Ind., has overcome this nuisance by enclosing a clinker compartment in their stoker furnaces. Clinkers are raked directly into a 12-gal. removable can behind the front panel, and no dust escapes. The container requires emptying only at long intervals.



**OVERHEAD GARAGE DOORS** made of airplane aluminum have been designed by the Berry Door Company, of Birmingham, Mich., for the postwar market. Although light in weight, the door is extremely sturdy, the manufacturer reporting that it will neither sag nor buckle when properly installed. A child can operate it with ease.





# Gus Gets into a Tight Spot

## NO SPECIALIST ON BOATS, HE HAS HIS TRIAL BY FIRE

SEVERAL of us regulars were sitting around the Model Garage shop watching Gus Wilson work when State Trooper Jerry Corcoran came in and handed him a newspaper clipping.

"News of your old friend," he grinned.

Gus read the clipping and whistled softly. "So they got him at last," he said.

"Who got who?" somebody wanted to know.

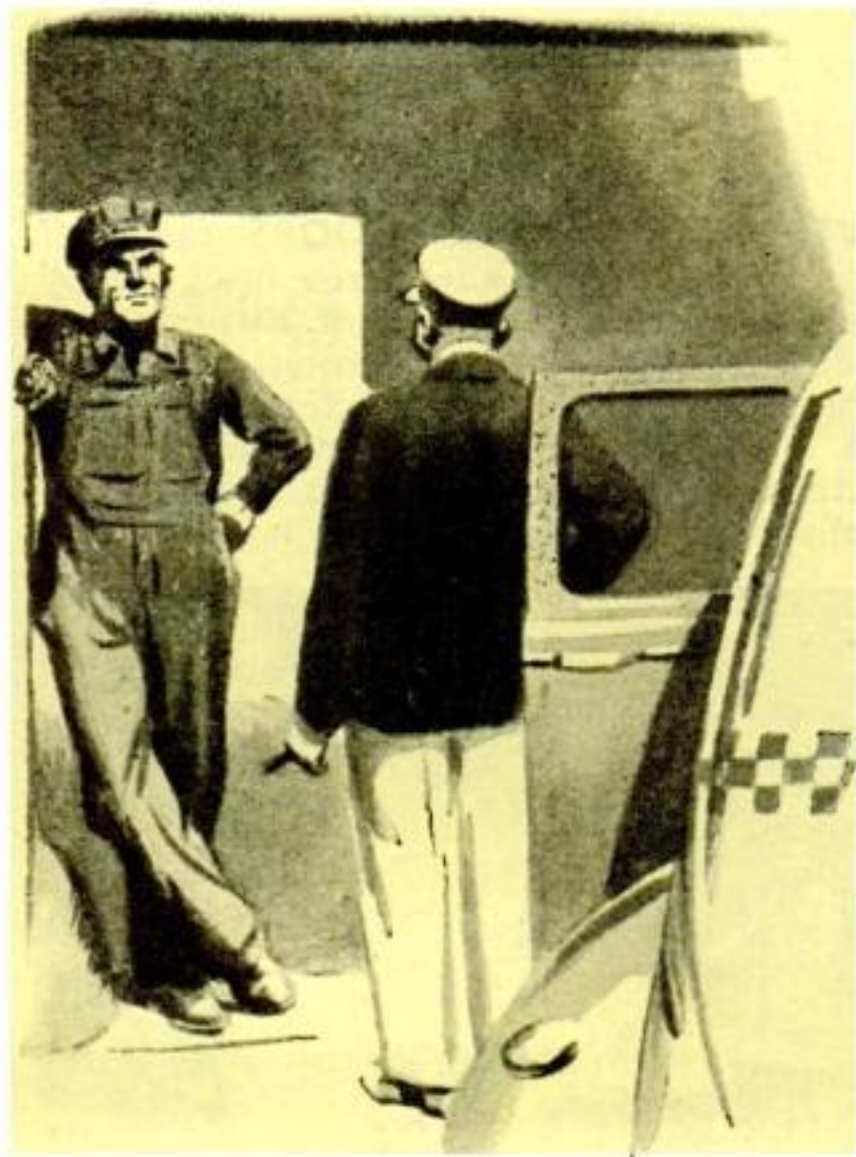
"The G-men got 'Slicker' Bailey," Jerry told him. "They've been after him for . . . How long is it since your boat ride, Gus?"

"Seven years," Gus replied. "Well, he won't plan any more bank robberies. He made a mistake trying to shoot it out."

"Fatal," Jerry agreed. "But he was the smoothest caser in the business."

"What is this?" Doc Foley demanded. "What's a 'caser'? And why is he Gus's friend?"

"A caser," Jerry explained, "is a fellow who works ahead of a bank-robbing mob—plans the stickups and getaways. As for 'Slicker' being a friend—Gus won't deny he and 'Slicker' were once very close."



"Name your own price," the sporty man told Gus.

"Too close for comfort," Gus grunted.

"Remember the stickup of the First National in Greenport Harbor?" Jerry went on. "It was pulled on the Wednesday of Race Week. They got 40 grand, and there was only one clue—one of the mob appeared to have an artificial arm. By Saturday we didn't have a thing. Then Gus stepped in."

"I was shoved," Gus protested. "Forget it."

Of course we wouldn't forget it, and before we went home we had the story—part from Gus but most from Jerry. Here it is:

BEFORE the war even as industrious a man as Gus could take time out to relax once in a while, and he was doing just that in the shop doorway late that hot Saturday afternoon when a Greenport Harbor taxi drove up. The man who got out was a sporty-looking individual in ice-cream pants and a brass-buttoned blue coat, and the visor of his white-topped yachting cap was pulled down over a pair of penetrating gray eyes.

"You look comfortable," he smiled.

Gus grinned back. "I was about to close."

"Know anything about marine engines?" the visitor asked.

"Well," Gus said cautiously, "they're a little out of my line. Greenport Harbor is where you find the experts."

"I just came from there," the yachtsman nodded. "Every mechanic in the place is up to his ears in work. And I want to be on my way tonight. My name's Gillingham—J. C. Gillingham, Chicago. I've got a motor yacht over in the harbor. Been there all week watching the races. Last night my engineer came aboard drunk, and I had to fire him. I don't know a lot about engines, but once we get going I'll do all right. The trouble is I can't get the engine started. Drive over with me and start the engine, and then name your own price."

Gus hesitated, and Gillingham laughed. "Be a good guy!" he urged, and Gus gave in.

Through the drive to Greenport Harbor and during a good dinner at a roadhouse, Gillingham talked familiarly of men Gus knew to be prominent in the shore community.

"Most hospitable crowd I've ever run into," he declared. "Made me feel as much at home in their club as I do in my own. Even old Jonas Manderville. When I dropped in to see him about a little business matter,



By  
**MARTIN  
BUNN**

I figured he was just another small-town banker, but after we'd talked for half an hour he offered me a guest card at his golf club. Too bad his bank was robbed."

It was evident when they reached the yacht club that Gillingham was popular there. He replied jovially to the hails of a dozen or more members, most of them dressed exactly as he was, but he kept on going. "Here's my dinghy," he said when they reached the dock.

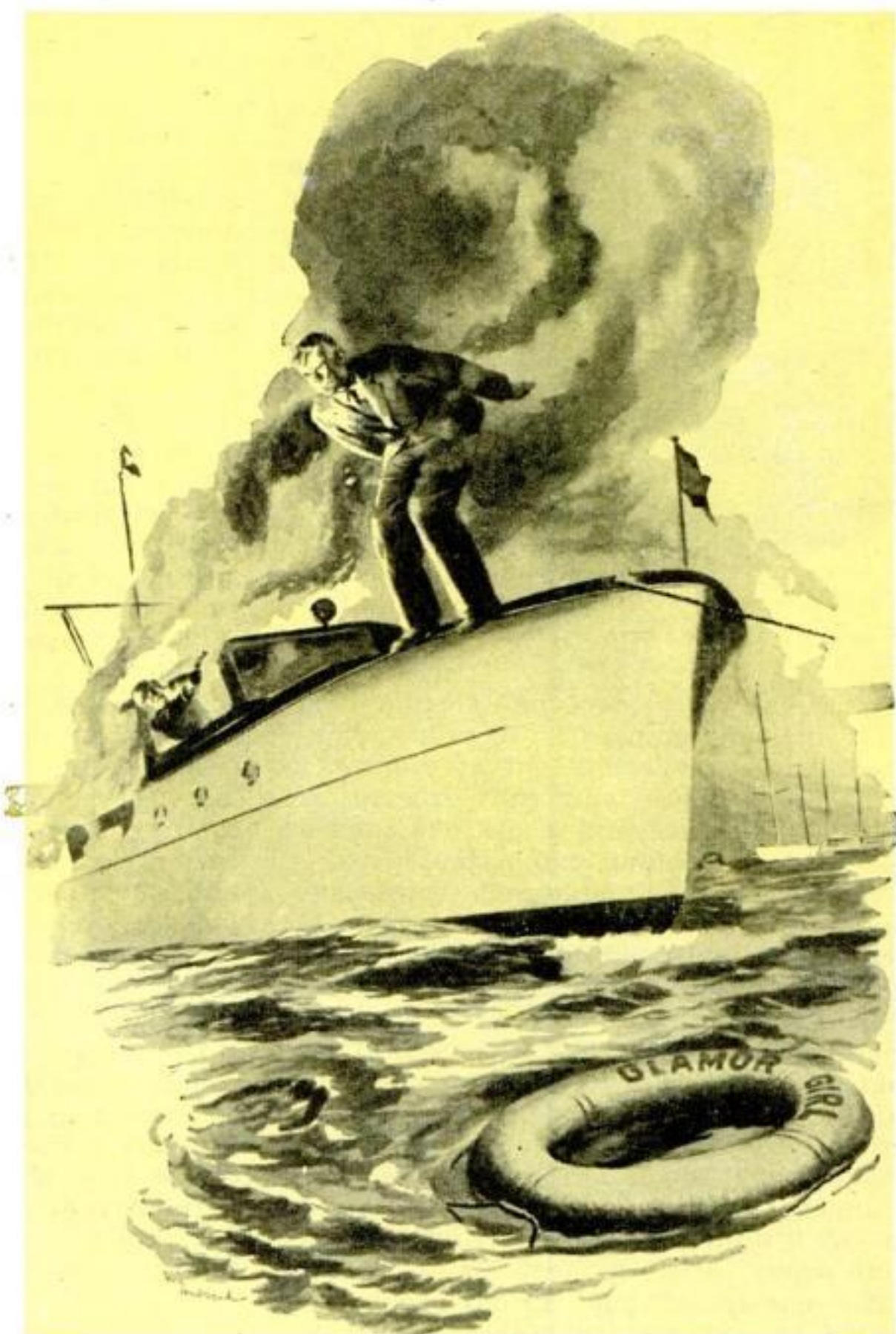
They got into the boat, Gillingham spun the outboard motor into activity, and they put-putted down the harbor past sleek tall-masted racers and smart power yachts that loomed vaguely in the warm, growing darkness. Finally they came alongside a big motor cruiser that lay at the mooring buoy farthest out. When they climbed aboard, a man came along the deck toward them.

"Fellow to fix the engine," Gillingham told him, and led the way into a dimly lighted main cabin where three men were playing cards. Their faces in shadow, they stared silently. "Fellow to fix the engine," Gillingham said again, and Gus followed him through a passageway, with closed stateroom doors in the bulkheads at either side, and into the engine compartment.

Gus took off his coat and went over the engine. It was an old one that hadn't had too good care, but there didn't seem to be anything seriously wrong with it. After five minutes of checking he found out why it wouldn't start—the fuel-pump filter was clogged. He cleaned it and asked Gillingham to press the starter button. The engine roared into life at once.

"That's fine," Gillingham said. "I'll fix it with one of the boys to take you ashore. Be right back."

"I'll have to wash up first."



An automatic cracked. He tossed a life ring to the water, and dived.

"Yes, of course," Gillingham said over his shoulder. "First door on your —."

The cabin door slammed, and Gus didn't hear the rest. He picked up his coat, went into the passageway, and waited. After a minute he got impatient and tried the knob of a door. It turned, and he pushed the door open. A light was on, and he stepped into a small stateroom. He looked around for a wash basin—and his jaw dropped.

On top of the built-in chest of drawers lay a human arm, its hand in a black glove!

Gus's heart skipped a couple of beats. Then he grinned. It was an artificial arm, of course. Then his heart skipped again as he remembered something Jerry had told him—that one of the thugs who stuck up the Greenport Harbor bank had an artificial arm!

[Turn the page.]





He held the lighter flame against the copper pipe.

A rasping voice made him start. "What are you doing in here?" A sallow, hard-faced man was getting out of a bunk in which he had been lying fully dressed. He had only one arm—and in his lone hand he held a wicked-looking automatic.

There were quick footsteps in the passageway, and Gus turned to see Gillingham, his face still smiling but his gray eyes hard.

"I'm sorry," Gus said. "I was looking—"

"You're going to be sorrier!" the one-armed man grated. He, too, looked at Gillingham. "No use trying to bull him, 'Slicker.' He's wise—I seen it in his eyes. Get outa the way while I plug him."

"We're still in the harbor, you hophead," Gillingham snapped. "When we get outside we'll drop him overboard—with something heavy tied to his feet."

The one-armed man grunted grudging assent, and he and Gillingham went out, locking the door behind them.

Gus had good reason to be scared—and he was. He sat on the bunk and tried to figure a way out. Then he heard the engine start, and in a short while the motion of the boat told him they had reached open water. There were cigarettes and a lighter on the bunk. He lit one and looked around. His eye caught a small-diameter copper pipe running along the bulkhead. He examined it closely, and hope flared. "Looks like the fuel line," he muttered. "If it is—" He snapped the lighter and held its flame against the pipe.

For what seemed like minutes nothing happened. Then the engine stopped. Gus grinned. "Thought so—vapor lock," he whispered. He kept the flame against the pipe until he heard footsteps, and then he sat quickly on the bunk. The door opened,

and Gillingham and the one-armed man came in.

"Something's wrong again," Gillingham told Gus. "We'll make a deal. You get the engine running, and keep it running, and we'll put you ashore safe and sound."

"All right," Gus said. "I'll do it."

With the one-armed thug at his heels, he followed Gillingham into the engine compartment. After faking a quick examination, he told Gillingham to press the starter button. He did, but nothing happened.

"Wait a minute," Gus said—and he noticed that Gillingham left the ignition on. He disconnected the fuel line, primed the carburetor with enough gas to run the engine for 10 or 15 seconds, and set the throttle wide open. Now he was sure that enough time had passed for the vapor lock to have cleared away. He pointed the disconnected end of the fuel line at a spark plug and said: "Try again."

Gillingham pressed the starter button. Gas spurted on the spark at the plug and instantly there was a flash of blinding flame. Gus jumped backward and crashed into the bulkhead. Fresh gas, pumped through the disconnected fuel line by the racing engine, burned viciously. Gus picked himself up to grope his way to the deck. Someone yelled, and an automatic cracked. Gus leaped across the deck, wrenched free a life ring lashed to the rail, threw it far, and dived.

He stayed under water as long as he could. When he came up the cruiser was blazing from stem to stern. He saw the life ring a dozen yards away, swam to it, and worked his way out of the glare of the burning boat. Half an hour later he was picked up by one of the motorboats attracted by the fire.

DOC whistled. "What's the end?"

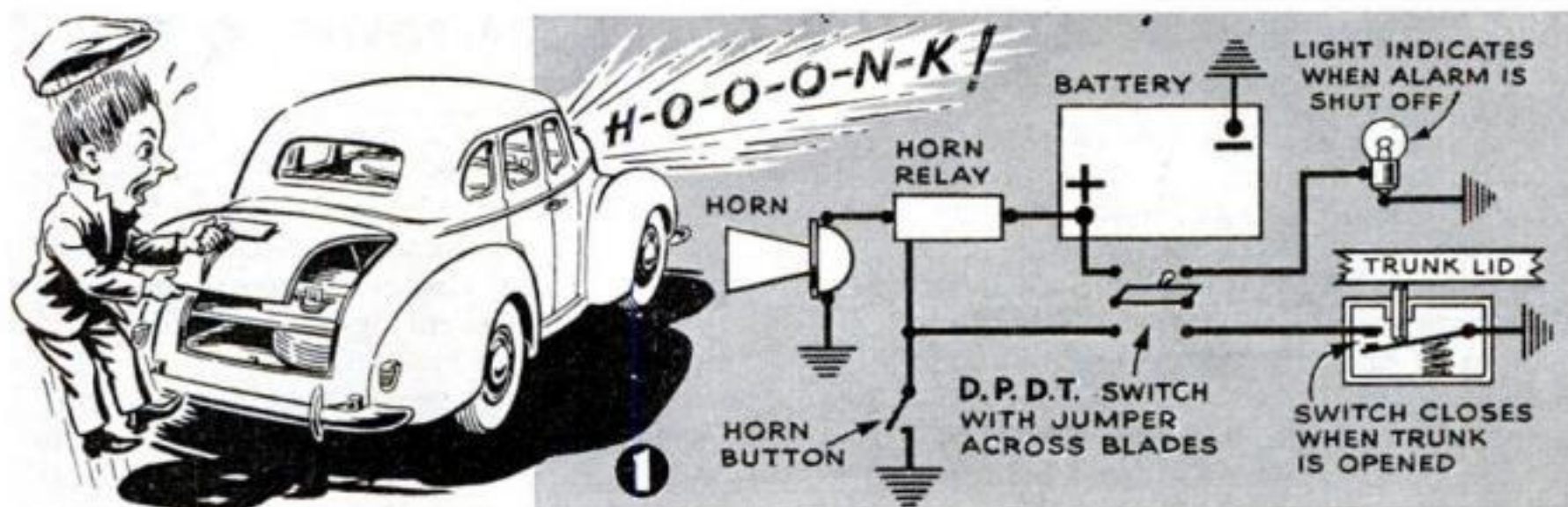
"This is the end," Jerry said, holding up the news clipping. "What was left of the one-armed thug and one of his pals was found on the boat. Two others got away in the dinghy, but we were waiting for them when they landed. Both had big rolls, and they squealed on 'Slicker' Bailey."

"Gus's story was kept out of the papers so 'Slicker'—if he was alive—wouldn't find out he'd been squealed on. He was alive all right—he could swim like a fish. And pretty soon some more bank jobs turned up that he might as well have signed his name to. But he was slick, and it took the G-men seven years to catch up with him."

"Yes," Gus said, "they always get their man, though. But since you fellows took to making a club out of this shop, I never get a decent dinner—I always get down to the Park House after the meat's gone. Scram!"

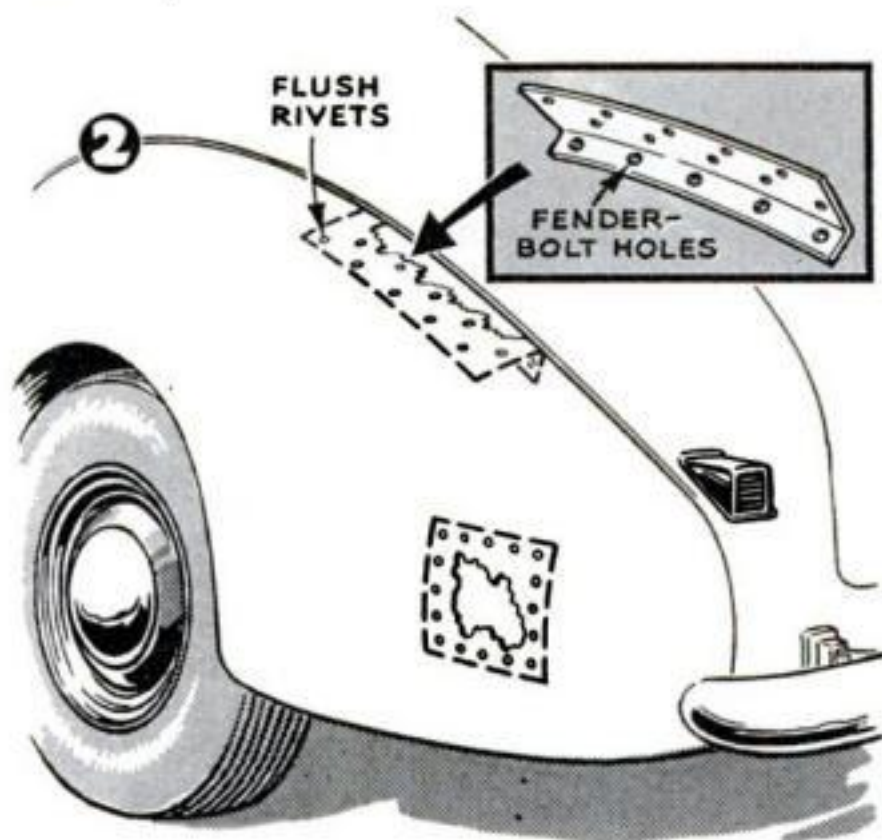


# USEFUL AUTO HINTS

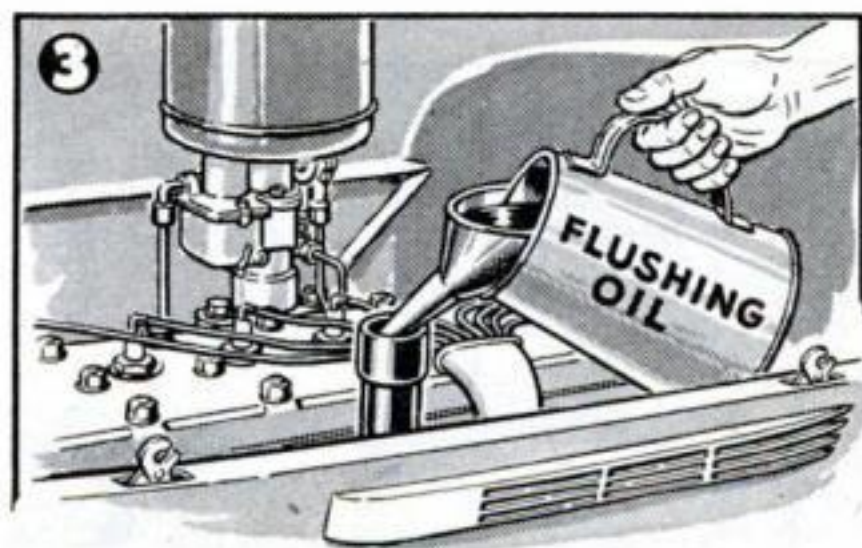


**1** THIEVES breaking into a car equipped with this alarm would set the horn blowing. The alarm circuit uses one or more door switches (the type that automatically controls refrigerator lights) installed under the trunk lid or in the doors. Connect them to one side of a double-pole double-throw switch on the instrument panel and a pilot light to the other. The light is a reminder to throw the switch.—J. H. P.

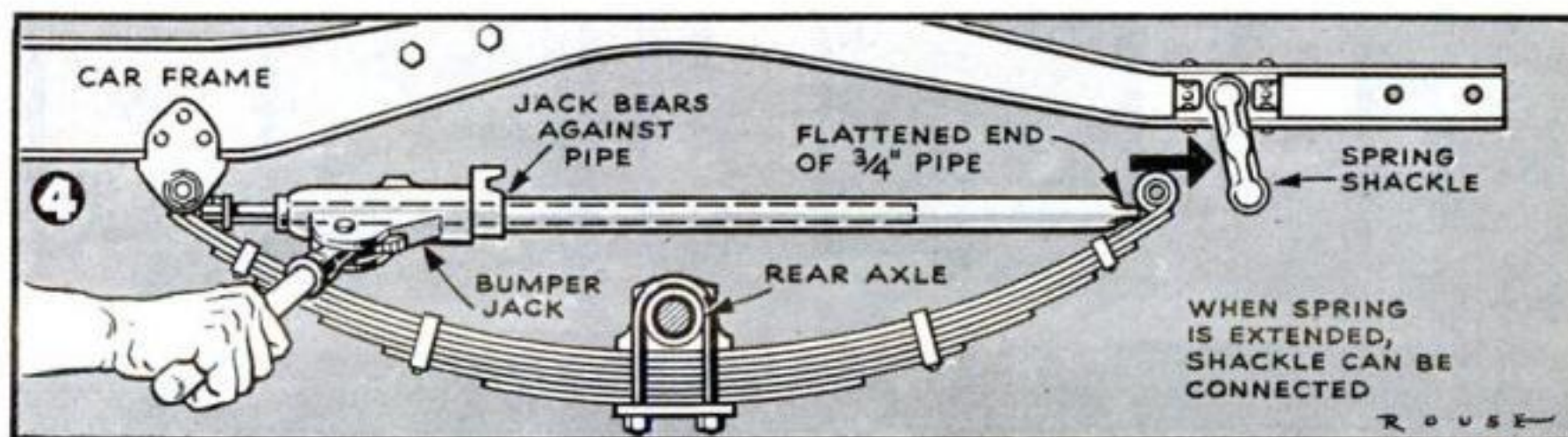
**2** RUST HOLES in fenders can be repaired by forming a sheet-metal patch to the contour of the underside, attaching with rivets or machine screws, and applying putty and paint. Countersink the rivet holes and file the heads flush. For a break adjoining the body, bend down one edge of the patch, drill holes corresponding to those in the fender edge, and bolt the piece to the body.—J. H. D.



**3** FLUSH OUT an engine before dropping the oil pan for crankcase repairs. This makes cotter-pin, nut, and bolt removal easier. You also stay cleaner.—H. D. JR.



**4** EXPANDING A SPRING may be done with a bumper jack and a piece of  $\frac{3}{4}$ " pipe flattened at one end. Rest the jack base and the pipe against the ends of the spring and work the jack until the shackle bolt can be inserted.—N. S. BEEBE.





# Water-Alcohol Cocktail

INJECTION USED IN PLANES ALSO GIVES EXTRA POWER TO CARS

By Merrill Folsom

THERE is an adage that gasoline and alcohol don't mix. When the latter is taken internally by the driver, this may be all too true; but injected into the combustion chamber of the automobile engine—that's a different story.

And it may come as a distinct surprise to motorists, long tormented into sulphurous diction by frozen fuel lines and sputtering engines, to learn that water in the combustion chamber adds materially to the performance of a car and to economy of operation. It will relieve their feelings to know, however, that the water is not mixed with the gasoline in the tank but is piped to the combustion chamber through a separate system.

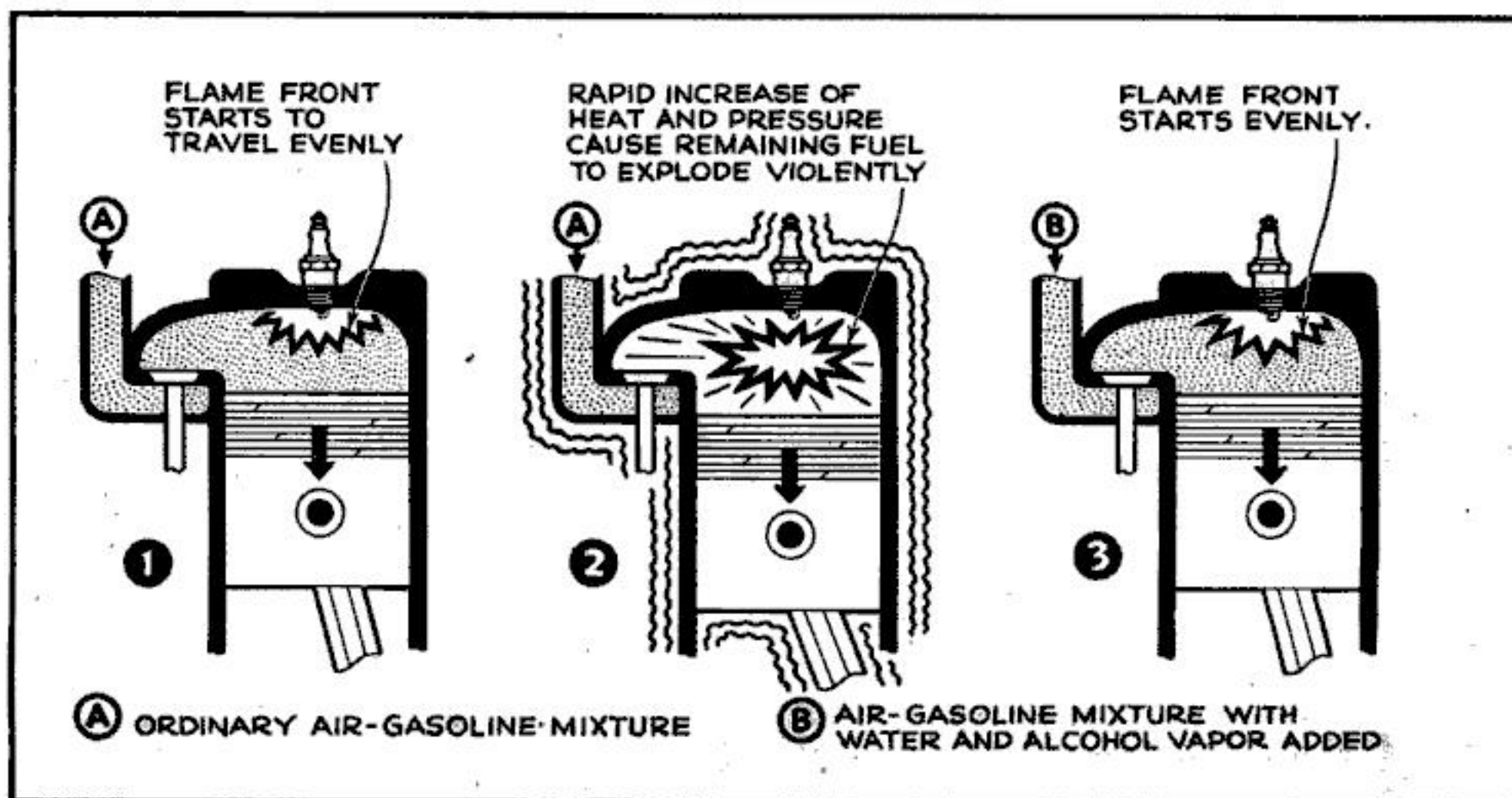
Both alcohol and water are internal coolants in combustion engines. They suppress preignition and detonation and draw higher power output from low-octane gasoline. Water alone is good, straight alcohol is the most effective, a 50-50 mixture of the two costs less and is completely satisfactory.

Rainy and foggy weather is usually considered depressing, but it has an opposite effect on the explosive powers of petroleum. On stormy and humid days, and especially nights, you undoubtedly have felt that your car possessed greater power, knocked less,

and ran more smoothly than on bright, sunny days. The reason for this increased efficiency was the moisture-freighted atmosphere itself, helping to clean carbon deposits from the engine, smoothing valve operation, and preventing gummy sludge in crankcase oil.

Automotive engineers experimented long ago with devices to inject water into the intake manifold to attain improved performance. Engineers in this country, Hungary, England, and Germany wrestled with the problem even in the days when automobile tops were extra equipment and snappy runabouts boasted a top speed of 40 miles an hour. But the work usually stopped at the experimental stage because of a general demand for engine simplicity and because of an abundance of good-quality gasoline at low cost.

While these experiments were being made, a few mechanically minded car owners got out drills, copper tubing, and petcocks, and rigged their cars with pipe lines that carried moist air from the tank at the top of the radiator head into the intake manifold near the carburetor. They hit on a formula that was scientifically sound, for the moist air did not rise from the radiator core and pass into the combustion chamber of the engine until the engine was thoroughly warm and able to handle properly the extra lift in power

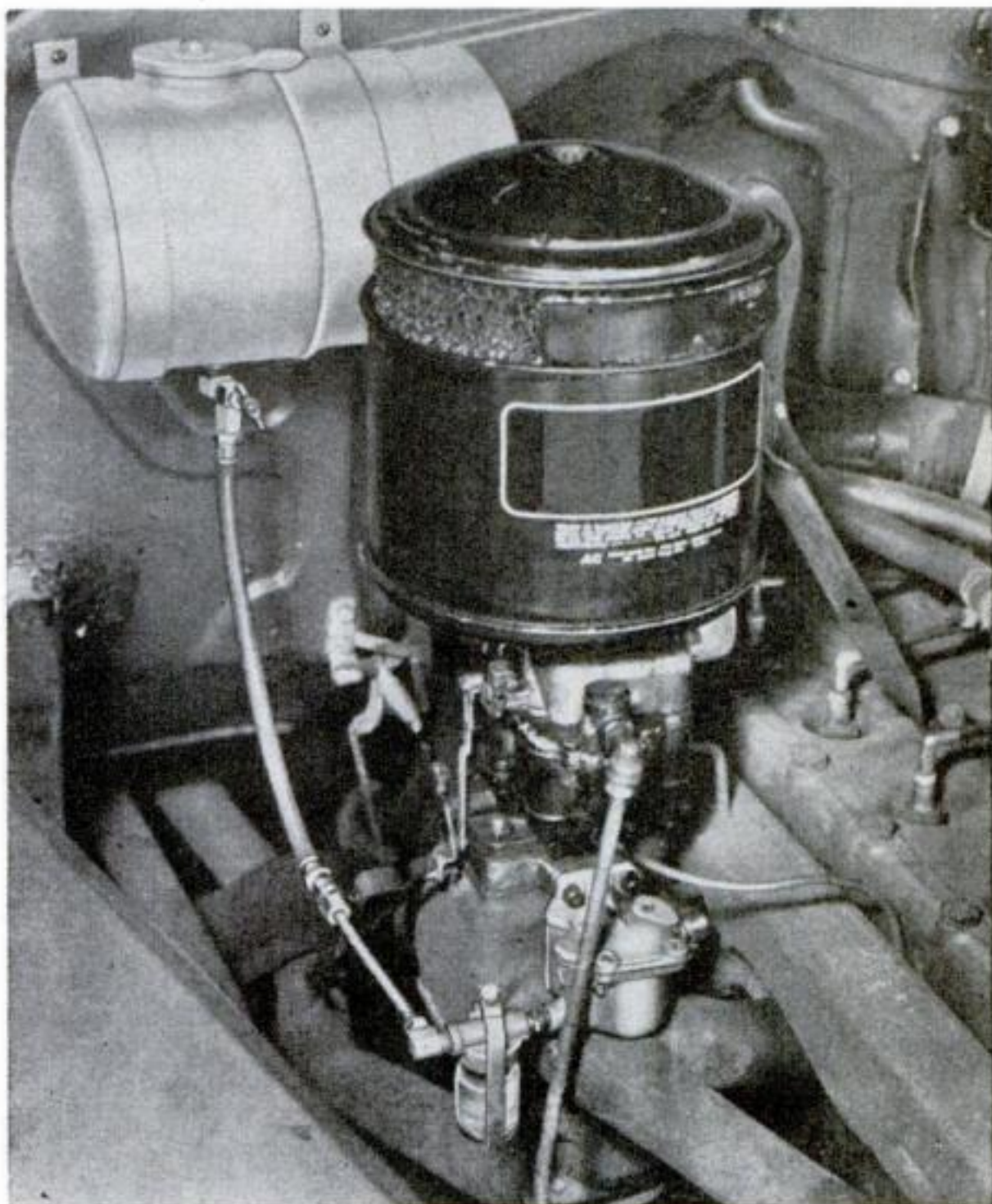




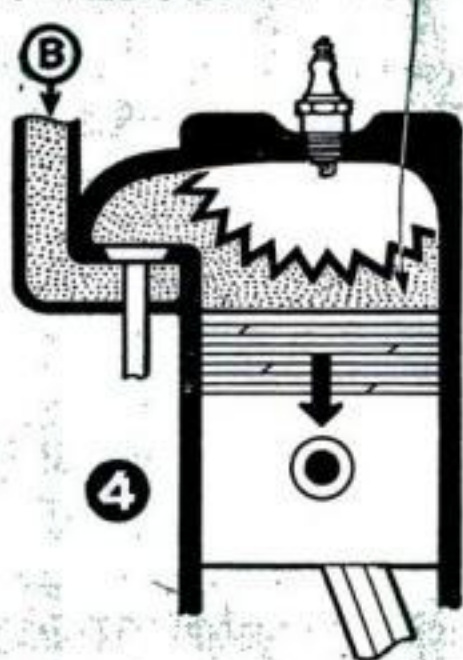
# Peps Up Auto Engines

that the moisture could give. But the makeshift water feeder was something short of ideal because of its failure to regulate the flow of moist air at various engine speeds.

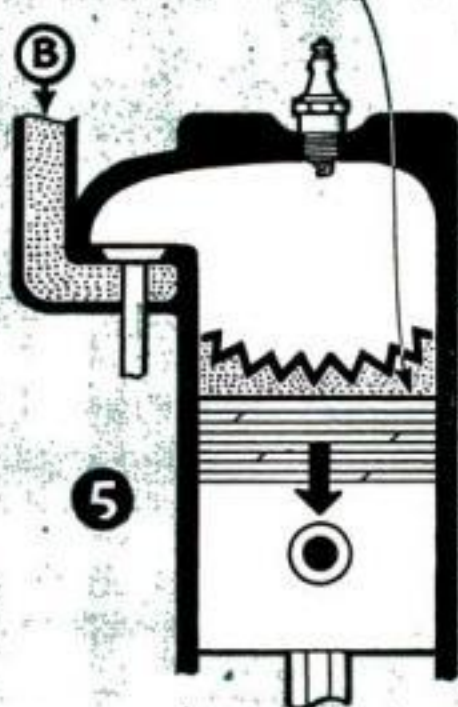
Recent tests have produced much new information about how fuel composition, combustion-chamber design, air-fuel ratio, ignition timing, and engine temperature affect the combustion process. The injection of water or water and alcohol into the combustion chambers of aircraft engines, especially supercharged engines, permits large gains in power without an increase in cylinder temperature. An extra surge of power has been helpful in getting heavy planes off the ground and in making fighter planes swifter in combat. The injections are equally effective in automobiles, especially if supercharged engines are used. They permit the design of high-compression



NO DETONATION BECAUSE COOL VAPOR HOLDS DOWN TEMPERATURE BEYOND FLAME FRONT

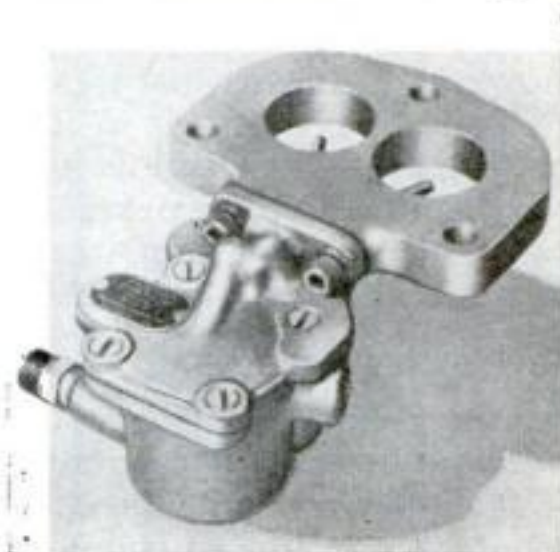


CONTROLLED, PROGRESSIVE COMBUSTION GIVES FULL POWER



Above and below, a water-alcohol injector unit for adding power to low-octane gas. The coolant, in the tank at top left, flows to the unit over a sediment trap.

There it goes through a vacuum compensator (lower left below), into a mixer to combine with the gasoline-air vapor, and on to the intake manifold of the engine.

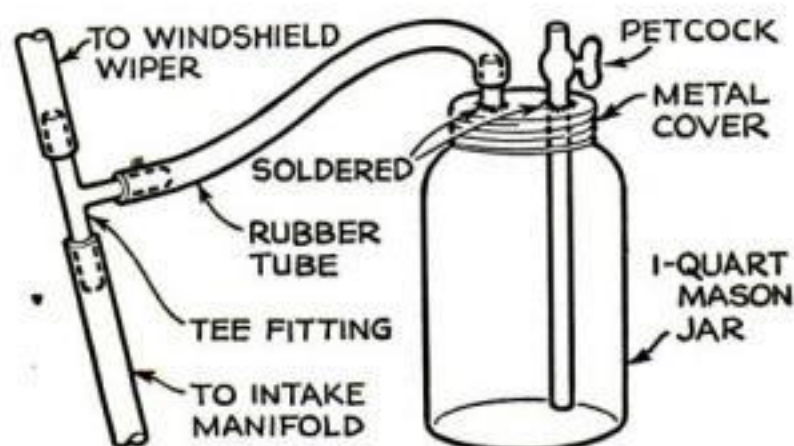




## Mason Jar Holds Coolant for Injection into Auto Engine

SOME improvement in auto performance on present-day low-octane fuels can be secured with this homemade water-alcohol injection device. While it will not make a low-octane gasoline behave like a premium gas—due mainly to the fact that intake-manifold vacuum lessens during acceleration, when it's needed most—the device affords an easy way to experiment with injection coolants.

Insert a tee fitting in the windshield-wiper vacuum line and connect it by rubber tube to a 1" length of  $\frac{1}{4}$ " copper



tubing soldered in a hole punched in the metal cover of a Mason jar. In a second hole in the cover, solder a 6" length of the tubing and solder a petcock to the upper end.

Mount the jar securely on the fire wall and fill it three quarters of the way up with the coolant. Start the motor and adjust the petcock until the bubbles come in a small, steady stream.—STEPHEN J. BENNIS.



engines of minimum weight whether supercharging is used or not. Alex Taub, noted automobile engineer, explains it thus:

"The effect of any cooling agent upon detonation is clarified by taking the process of combustion in stages. In an average passenger-car engine, the first stage is the ignition. At first gas pressure is simply compression pressure, or around 150 lb. per square inch. The second stage comes when the flame has traveled about a third of the distance. Gas pressure in the unburned portion then is about 250 lb. And the third stage comes when the flame front has moved two thirds of the way across the combustion chamber. At that point the gas pressure in the unburned third is 350 lb.

"From there on, what happens depends on the temperature of the last gas to burn. This gas, if it is in the hot area, would be ready to detonate with very little flame movement. If this last gas is in a cool area, or has had the benefit of a cooling medium, or if its temperature is held down by the work done and the work going on in vaporizing a cooling medium, then, obviously, the flame front completes the travel without self-ignition taking place in this last gas. Thus there is no detonation."

After experimenting with a mixture of water and alcohol in equal parts, engineers of Thompson Products, Inc., of Cleveland, reported to the Society of Automotive

Engineers that the best gains in economy and operating efficiency are achieved when fuel of approximately 12 octane numbers lower than that normally required by the engine must be used. They said that not only was knocking eliminated but the injections caused a softening and expulsion of carbon from the engines, reduced crank-case sludge, and resulted in no corrosion or alkali deposits in the engine.

The use of a special internal coolant is not intended as a substitute for the anti-knock ingredients already in the gasoline. Ethyl gasoline was perfected after tests on 30,000 compounds that would reduce fuel knocks and improve power. Alcohol contains little more than half as much fuel value as gasoline, and its use in the combustion chamber by injection is as a coolant rather than a direct source of power.

Explaining the engine speed at which water-alcohol injections are most useful, and the need of a device to start and stop the injections at various engine speeds, the Thompson Products engineering triumvirate of A. T. Colwell, R. E. Cummings, and D. E. Anderson reported to the SAE as follows:

"At higher speeds, volumetric efficiency is decreased and turbulence increased, lowering the octane requirement of the engine. However, at the speed of maximum torque and slightly above that speed, maximum detonation and shock take place. This



range, therefore, will require the maximum amount of internal-coolant injection. Beyond this range, the quantity can be reduced or entirely cut off."

Utilization of water-alcohol injection has the disadvantage of needing an additional fuel-supply system and the necessity of replenishing the supply. The advantages seem to outweigh the disadvantages, however. Some engineers are trying to simplify the additional fuel system by designing a combination carburetor and injector, while the latest device is a separate injector that can be attached to the intake manifold near the carburetor without interfering with the regular fuel system.

A tank for carrying the water-alcohol mixture should be about a tenth the size of the gasoline tank. It can be mounted

above or below carburetor level, but a pump will be needed if it is below. A combination gasoline and water-alcohol pump has been used satisfactorily.

Experience shows that the water used can generally be any that is good for drinking.

Many variables must be considered in computing the cost of injection. While a cheaper, lower-octane gasoline can be used, the economy to be effected depends largely on how wide open the throttle is kept. Greatest economy is achieved in the middle range of the throttle. Wide-open throttle decreases the economy.

There is another important factor, the Thompson engineers told the SAE. Because there is no need to retard spark to eliminate detonation, a more efficient spark position can be maintained when injection is used.

## Waterproofing Liquid Immunizes Motors and Wiring to Dunking

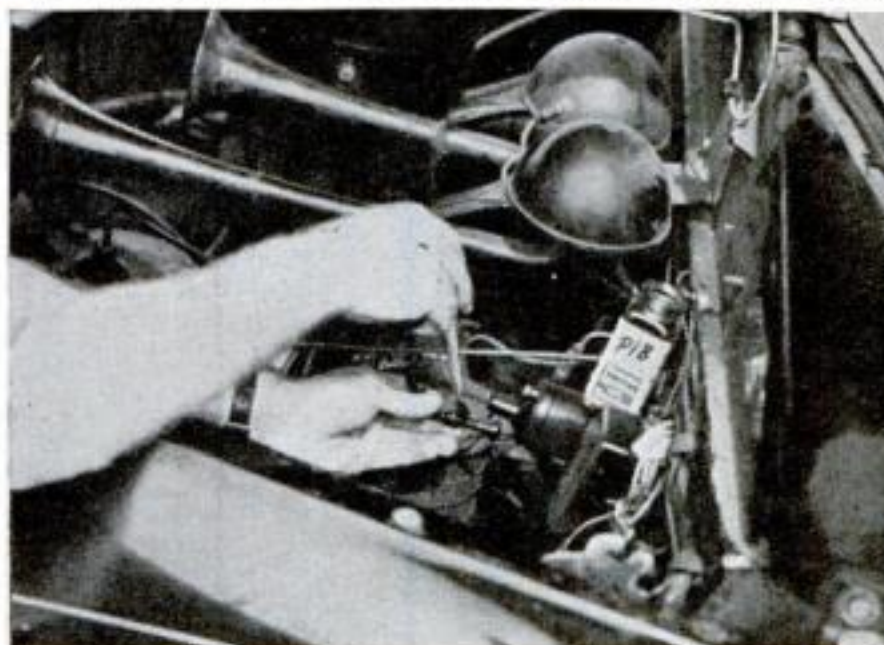
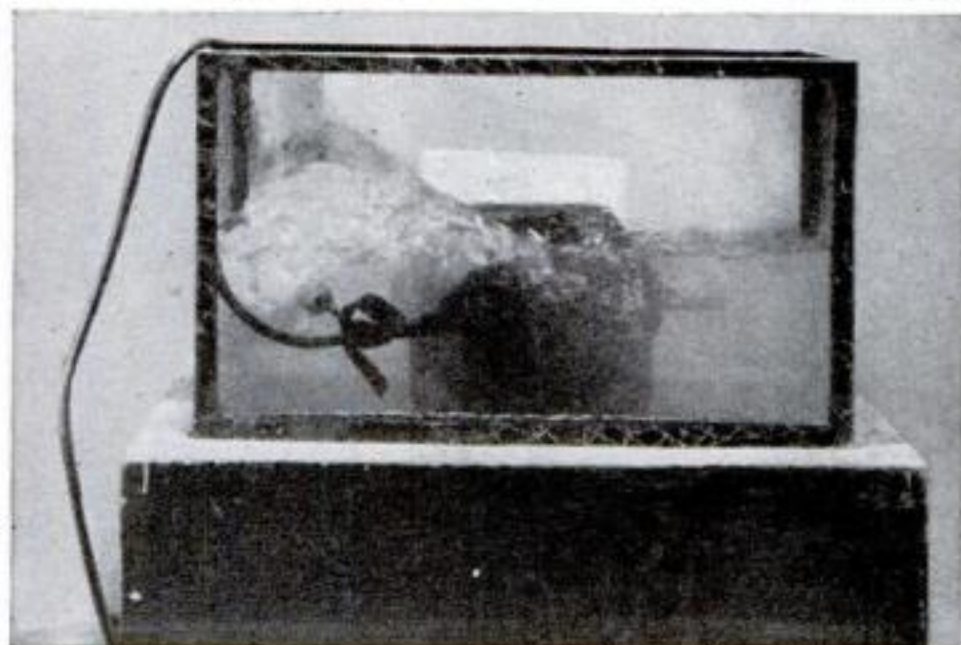
LIQUID insulation, a war development that waterproofed ignition systems in jeeps and other Army vehicles, is now available for civilian use. Applied to an ignition system, it renders the engine practically immune from water-caused stalling. It can also be painted on an untreated, water-soaked engine to permit quick restarting. An electric motor treated with the liquid and kept under water for two years was run while still under water during a demonstration.

The liquid penetrates other insulating material and forms a tight coating on the metal itself. It is used on auto wiring, spark plugs, and batteries, electric motors, outdoor wiring, flashlight batteries, and the like. U. S. Industrial Chemicals, Inc., of New York, makes it.

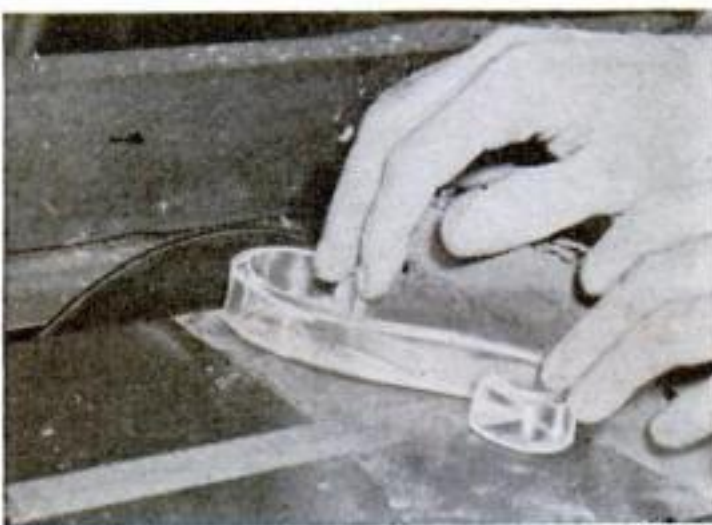
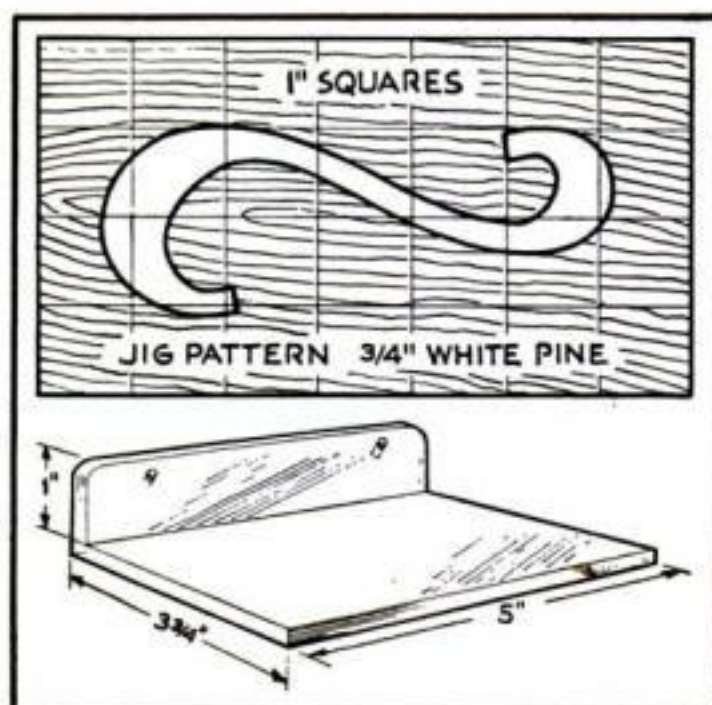
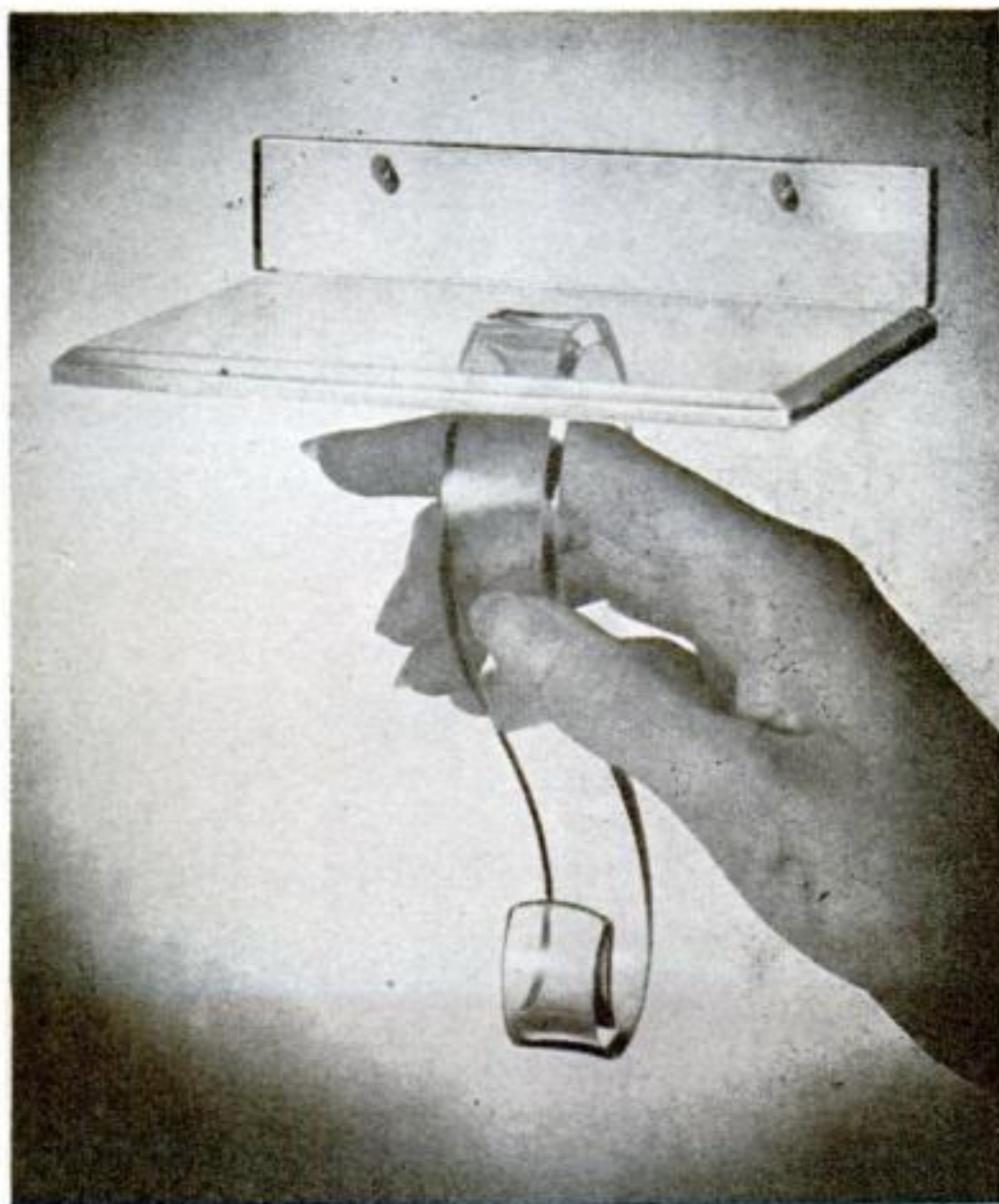


Two years under water apparently had no effect on this electric motor. Treated beforehand with an insulating liquid, it ran while still submerged.

Few cars get a wetting quite like that above, but in an emergency liquid insulation applied to the wet wiring with a brush (below) permits starting.







## Sparkling Plastic Wall Bracket Sets Off Colorful Knickknacks

CLEAR plastic, so suitable for projects placed where they can catch and reflect light, is at its best in a wall bracket like that shown above. Not only will it reflect light itself, but it will catch the colors of objects displayed on it.

The curled bracket on the bottom shelf is chiefly ornamental, but it can also furnish additional support if you take pains, when cementing it to the shelf, to place it so that it will just touch the wall behind. Cut a  $9\frac{3}{8}$ " length from a  $\frac{1}{4}$ " by  $\frac{3}{4}$ " strip of clear plastic, grind the ends round, and wet-sand and buff them. Then saw out a wooden

jig to the reverse-curve shape. Heat the kitchen oven to about 325 deg. F., and put in the plastic. When it is perfectly limp, remove it with gloves, insert it in the jig, and let it remain there until cool.

Make the shelf  $\frac{1}{4}$ " by  $3\frac{3}{4}$ " by 5", grind a chamfer on the three upper outside edges, and wet-sand and buff the ground surfaces. The back is a piece  $\frac{1}{4}$ " by 1" by 5" drilled for screws and ground square on the bottom edge for cementing. Grind a flat surface on the top curl with the miter gauge set at 80 deg. as above. Assemble all the parts with plastic cement.—MAURICE LANNON.

## Two Simple Tricks Facilitate Scribing and Sawing of Plastics



◀ SCRIBING marks on clear plastic are often difficult to see, but they become readily visible when you rub over them with soft crayon. Wipe off the excess color, and the line that you have scribed will show up clearly.—ROBERT KOTTMEIER.

PLASTICS sometimes show a tendency to gum a jigsaw blade unless a very slow feed is used. To overcome the friction that produces this heat reaction, rub a few drops of light oil on the underside of the part to be cut. Very little oil is needed, and a cleaner cut often results.—R. K. ▶



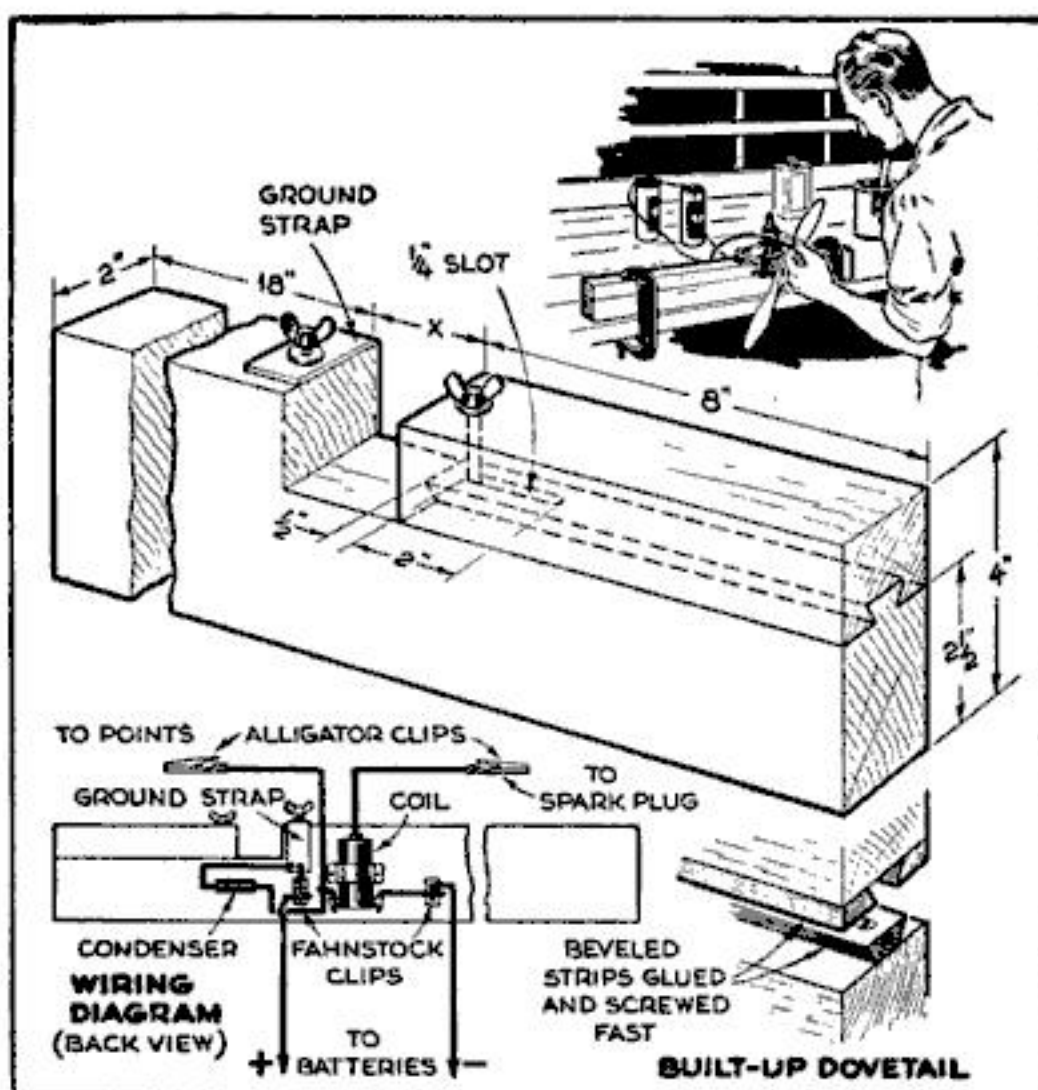


## Bench Mount Simplifies Model-Engine Testing

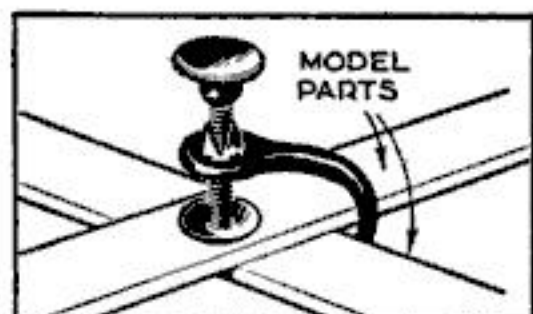
GAS ENGINES designed for model boats, racing cars, and airplanes seldom have mountings adaptable for shop tests. It is a comparatively easy matter, however, to build a bench mount that will hold such a motor firmly in place, even at top speed.

Cut a 28" length of two-by-four into two parts as shown at the right, build up a dovetail track on the adjoining sections with beveled strips, and drill a hole for a bolt  $\frac{1}{4}$ " in diameter  $\frac{1}{2}$ " from each edge of the jaw. Then cut a 2" slot in the section under the sliding jaw, using the hole already drilled as the point of origin. This makes it possible to vary the size of the jaw to suit any engine. Mounting flanges on the engine are clamped rigidly under a 1" washer and wing nut placed on each bolt. Slip a 2" by 4" piece of copper over the stationary bolt for a ground strap touching the engine.

Attach the spark coil to the back of the block, using a leather strap rather than a metal one, for the latter might set up eddy



currents and overheat the coil. As the diagram indicates, one wire leads to the engine points and another to the spark plug. Solder all connections to prevent vibration from loosening them.—MAURICE SCHOENBRUN.



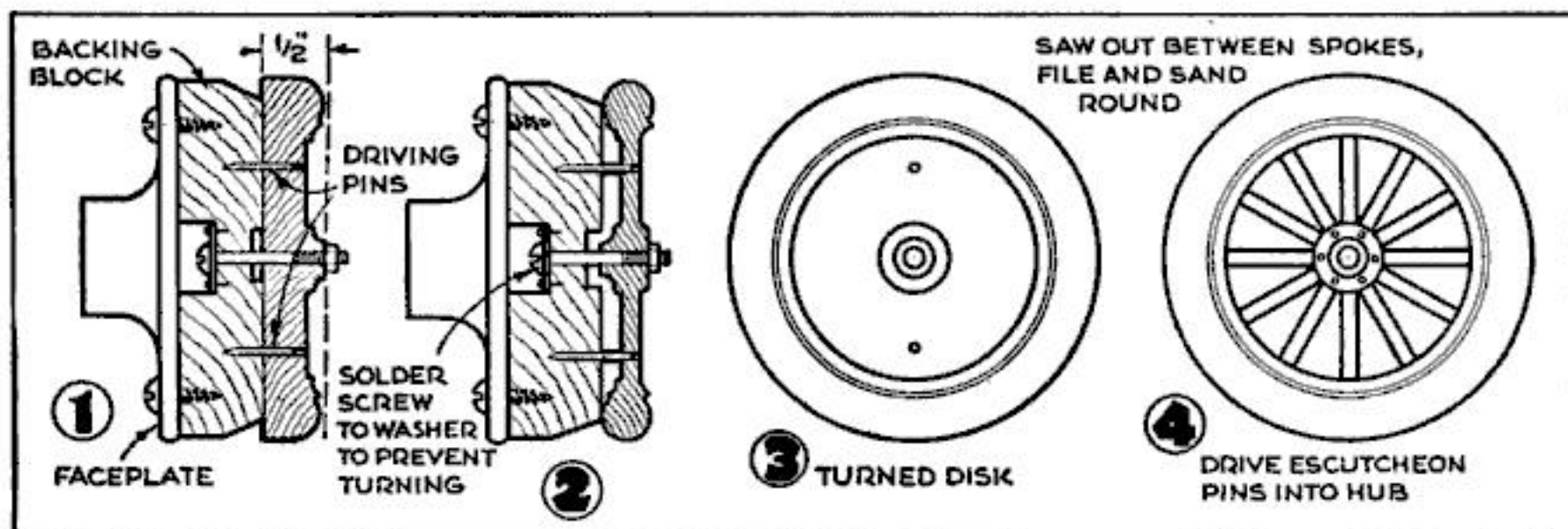
## Earrings Serve as Clamps in Modelmaking

CHEAP earrings from the five-and-ten make ideal clamps when tiny parts of a model must be glued together. Remove the pendant or other ornament, and the earring is ready for use. The screws will exert more than enough pressure to hold the parts until the glue dries.—D. H.

## Model Auto Wheel Formed in One Piece by Sawing Out Spokes

MINIATURE automobile wheels can be produced in one solid piece by cutting out the spaces between the spokes with a coping saw and then rounding off the spokes themselves with a file and sandpaper. This eliminates the task of fitting separate spokes

into the hub and rim. In turning the disk, mount the stock on the faceplate of the lathe as shown in Fig. 1 after soldering the center screw to the washer. When one face has been turned, reverse the wheel, as in Fig. 2, and complete the other side.—J. N. H.





# SKYHOOK...

lower end. The upper end rotates freely in a hole in the top of the fuselage with  $\frac{1}{8}$ " clearance all around. Power absorption in one rotor is constantly balanced by that of the other and an unbalanced torque condition cannot occur.

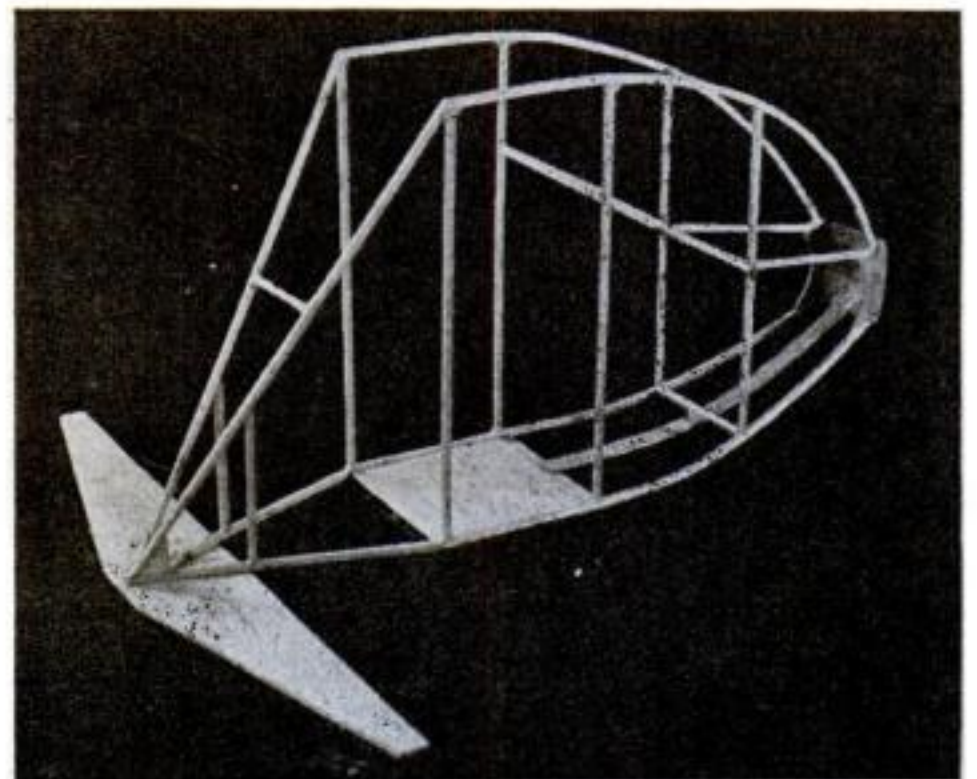
Elimination of torque is not enough, however, to obtain satisfactory flights in this type of model; hence the directional vane pointing rearward from the top of the fuselage.

As the downwash of air leaves the lower rotor, it does so with a rotary motion and tends to impart this motion to the fuselage and cause it to revolve in the direction of rotation of the lower set of blades. To forestall this effect, the vane is attached at approximately the same angle as the upper rotor, and in this position acts to exert a push in the opposite direction and keep the fuselage pointed straight. The tips of the lower rotor are bent downward at a 30-deg. angle to give adequate air flow over the directional vane.

A word of caution: A free-flight model helicopter is not an easy thing to build because of the number of "bugs" inherent in the helicopter idea. In fact, it might be said that if a model helicopter flies at all, it's good! Therefore, it is recommended that the plans be followed closely.

Try to keep the weight down. Do not dope or add unnecessary detail to the model. Excessive weight means more power will be required to fly it, and more power means more rubber, fewer winds, and more weight. This can develop into a vicious circle.

Notice mounting strip for the front wheel between the bottom longerons of this unfinished fuselage. A cross brace midway at the rear adds strength.



By ROY L. CLOUGH, JR.

ON DRAWING boards and in secret test hangars of at least a dozen major companies and scores of smaller ones the helicopter of the near future is being evolved.

Rotating-wing craft have caught the public fancy, and manufacturers are hurrying to perfect their direct-lift wares for the postwar market. Already at least three distinct types have flown successfully.

In the helicopter, torque effect is one of the major problems. If a single rotor were attached to a power source with no provision for this effect the entire fuselage would spin around and around. Two rotors revolving in opposite directions around a common center overcome this tendency.

Counter rotation is employed in *Skyhook*, a model that flies straight up like the real thing and, when the power is expended, descends in a spiral and lands on its wheels. *Skyhook* is best flown indoors, but may be sent aloft outdoors on calm days.

It will be noted that the motor tube, which also serves as a shaft for the lower rotor, is attached only by a simple bearing at the



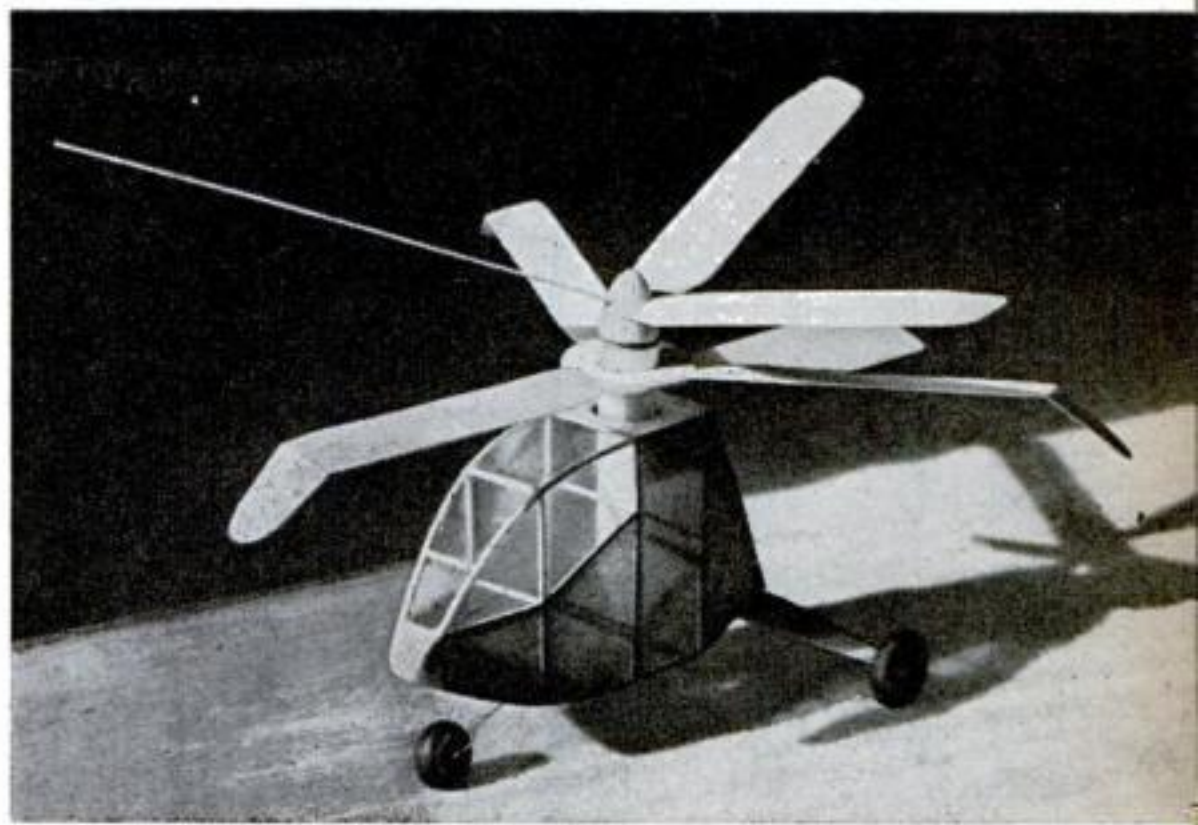
# A FLYING MODEL HELICOPTER

It is best to form the motor tube of  $\frac{1}{20}$ " medium-soft sheet balsa, but if this is not obtainable use  $\frac{1}{16}$ " stock, well sanded. To avoid splitting, soak the wood in hot water before bending it around a circular form and wrapping in place with gauze. If a form of the size indicated is not available, the diameter of the tube may be safely altered, but remember to change the hole in the motor guide plate accordingly to retain the  $\frac{1}{8}$ " clearance.

When the tube is thoroughly dry, slip it from the form and cement the edges together. Near one end of the tube cut two small holes in opposite sides for a short length of  $\frac{1}{8}$ " dowel to hold the end of the rubber motor. Run a bead of cement around the edges of these holes to prevent the wood from splitting.

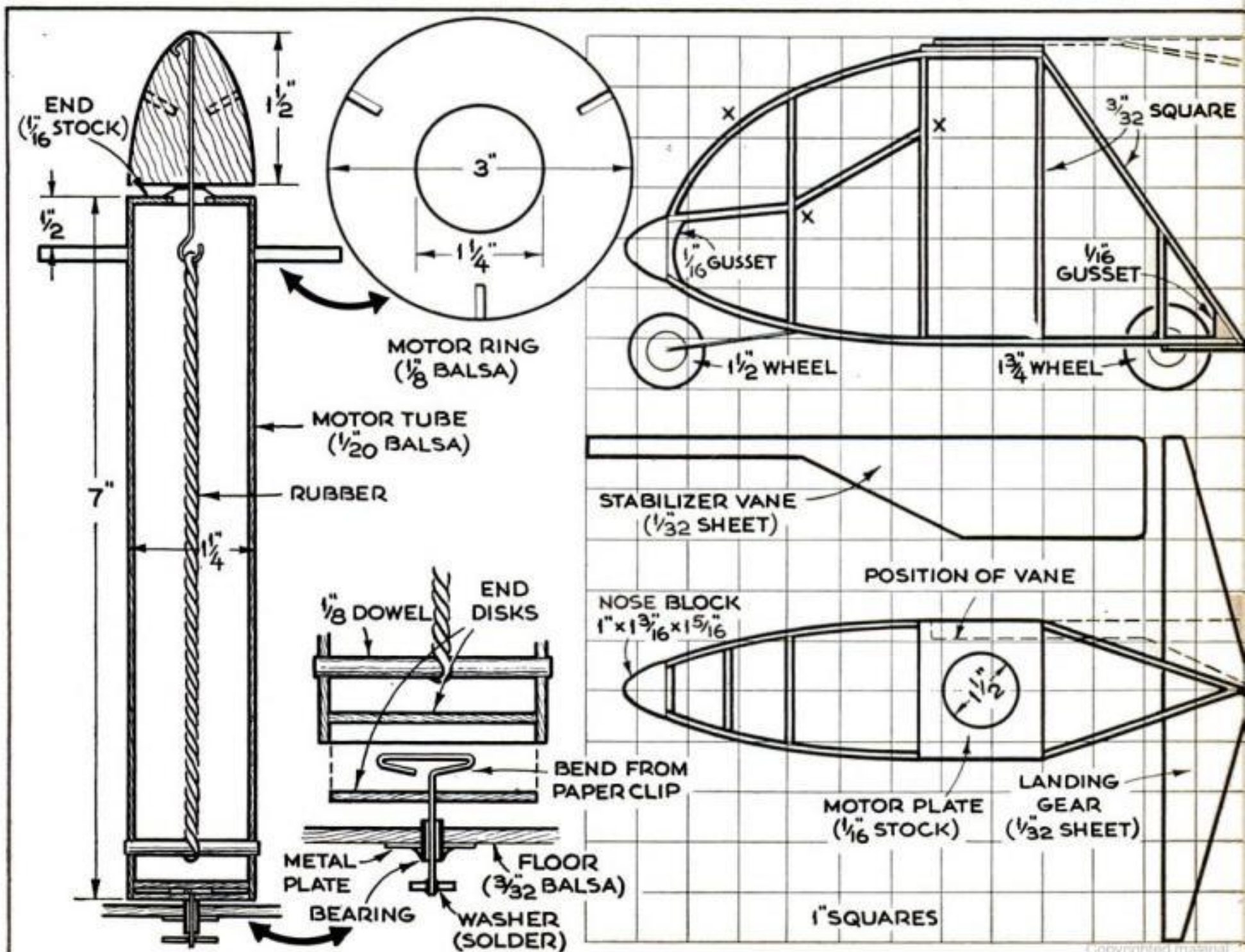
From  $\frac{1}{16}$ " medium stock cut three disks to fit closely inside the tube. Cement one flush with the upper end of the tube and another about  $\frac{1}{8}$ " inside the lower end. Keep the third for future use.

Build one side of the fuselage upon the

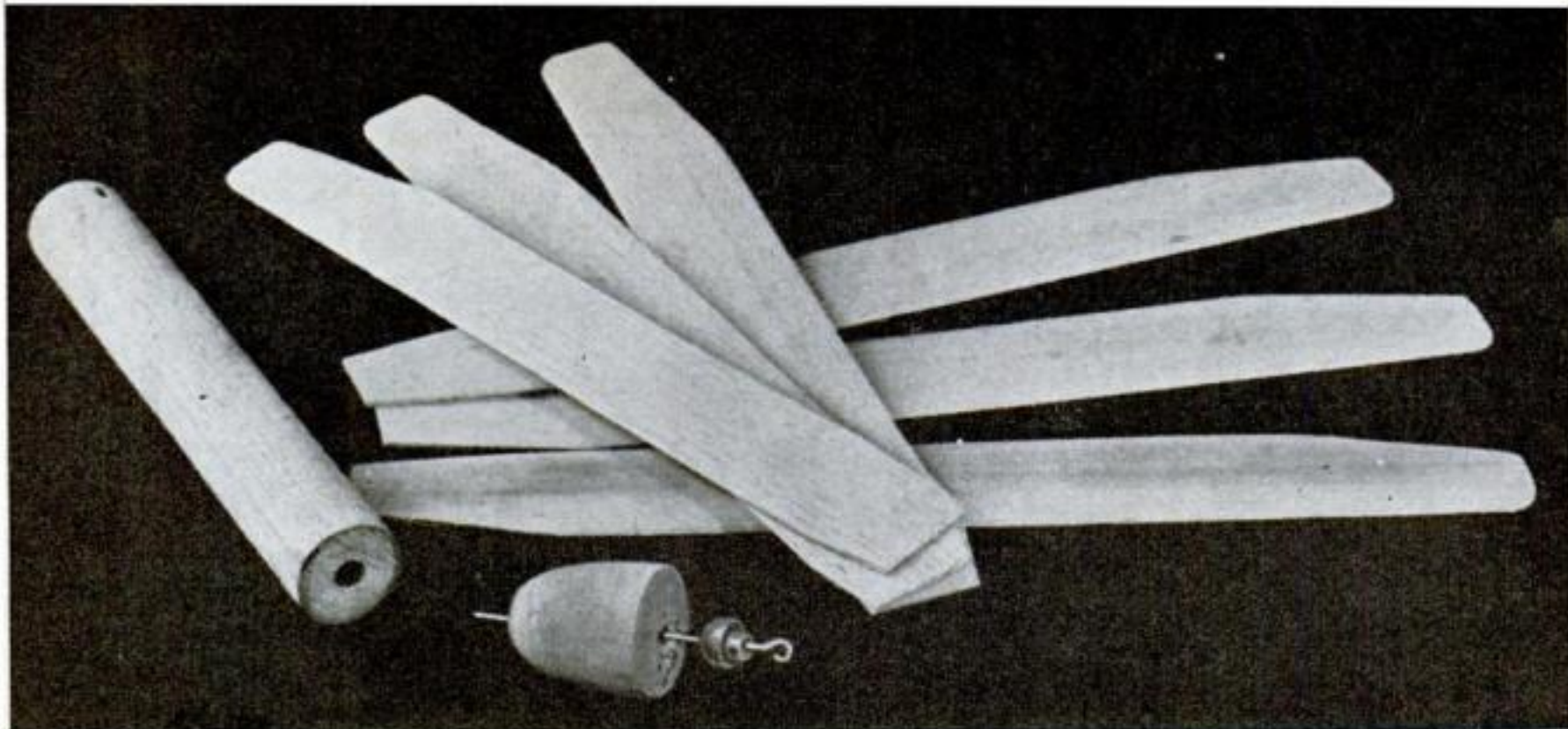


Two rotors revolving in opposite directions overcome torque.

other as in a conventional model, using  $\frac{3}{32}$ " square medium balsa strip. Soak the upper longerons in hot water before bending. Crosspieces are required at the points marked "X" in the plan, and another may be placed between the upper longerons near the rear for greater strength. The floor







Motive parts include six rotor blades, motor tube, and top rotor hub. Note lower blades are cut shorter.

plate shown in one photo is  $\frac{3}{32}$ " by  $2\frac{1}{4}$ " by  $2\frac{3}{4}$ ". Center a  $\frac{1}{32}$ " by  $\frac{1}{4}$ " strip between the lower longerons from the floor plate to the nose to support the front wheel.

Cover the windows with cellophane or light celluloid and place dark-blue tissue on the rest of the fuselage, except for the space occupied by the motor guide plate on top and the floor below. Water-shrink, but do not dope, the covering.

Form the landing gear from  $\frac{1}{32}$ " hard balsa sheet, cement it to the lower longerons as indicated, and mount  $1\frac{3}{4}$ " balsa or celluloid wheels on its ends with pins. Attach the  $1\frac{1}{2}$ " front wheel with a wire strut.

Cut the six rotor blades from  $\frac{1}{20}$ " balsa, well sanded. Notice that the plan below shows the top surface of the upper blades and the bottom surface of the lower, since the upper rotor moves counter-clockwise and the lower clockwise when viewed from above. Also notice the shape of the cross section. Do not dope these blades.

Carve the upper rotor hub from soft balsa and install the motor hook through a standard thrust-plug and bearing as shown. The motor ring may be cut from  $\frac{1}{8}$ " balsa, but two  $\frac{1}{16}$ " sheets glued together with the grain crosswise have greater strength. Cement the ring to the motor tube about  $\frac{1}{2}$ " from the upper end.

Attach the upper blades to the rotor hub at a pitch of 25 deg., with a 2" dihedral under the tips. Mount the lower blades on

the ring at 25 deg. but with no dihedral. Bend down the tips as shown. Make certain that all blades balance and track evenly.

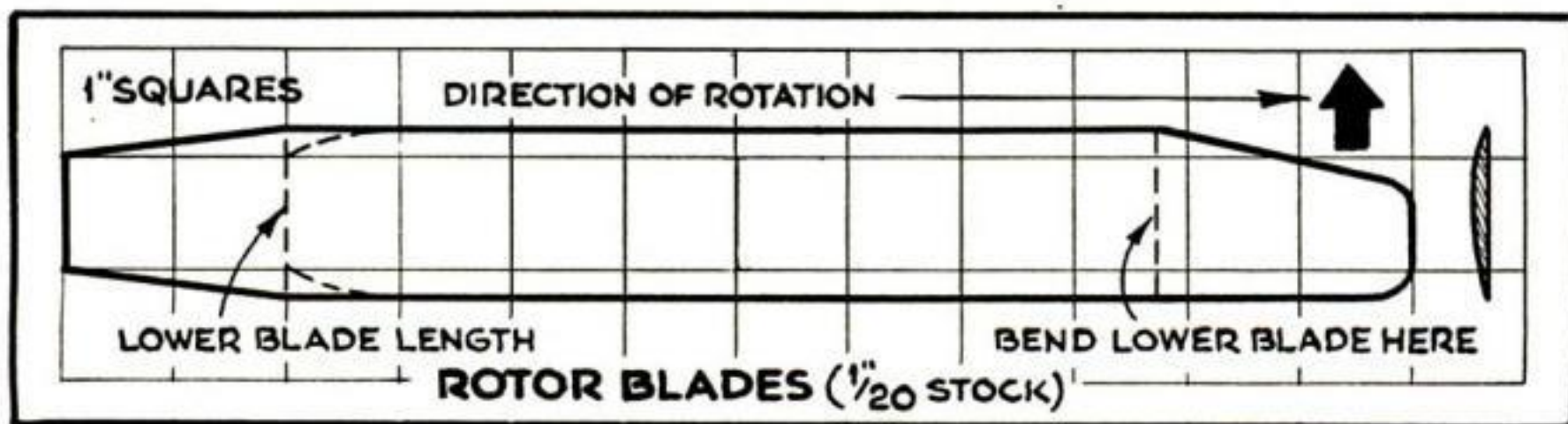
Now bend a paper clip to the shape shown on the plan so that it will stand upright. Thrust the stem through the third disk cut for the motor tube until the bent part rests flat against one side. Put plenty of cement into the recess at the lower end of the tube and push the disk with wire attached inside.

The lower bearing is a  $\frac{1}{2}$ " length of  $\frac{1}{16}$ " o.d. brass tubing soldered into a  $\frac{1}{2}$ " by  $\frac{1}{2}$ " piece of tin plate. Cement the latter to the center of the floor plate.

Next cut the directional vane from  $\frac{1}{20}$ " sheet and cement it to the motor plate at the point indicated on the plan. Wet the wood at the thin part and twist until the vane has approximately the same pitch in the same direction as the upper rotor.

Now install the rubber motor. About four loops, or eight strands, of  $\frac{1}{8}$ " flat rubber are required. Slip the tube through the motor guide plate and lower it into the fuselage. Poke the lower shaft through the bottom bearing. Solder a washer to the end to hold it, or bend over the end of the shaft, and *Skyhook* is ready for a trial flight.

All take-offs should be from a level surface. Hold the circular lower rotor hub stationary and wind the upper blades. Set the model on the ground with upper and lower rotors between forked thumb and forefinger and release both simultaneously.





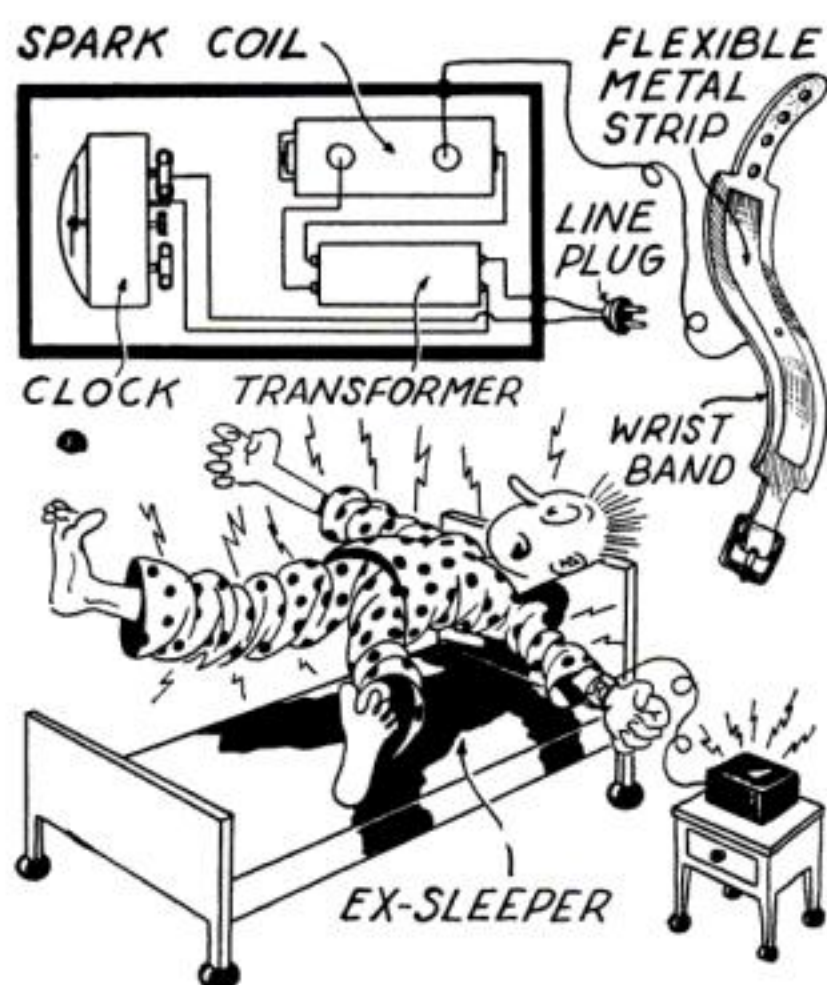
# What's Your Ingenuity Quotient?

*Have you pulled off a smart one lately? We will pay for each contribution accepted for this page showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.*

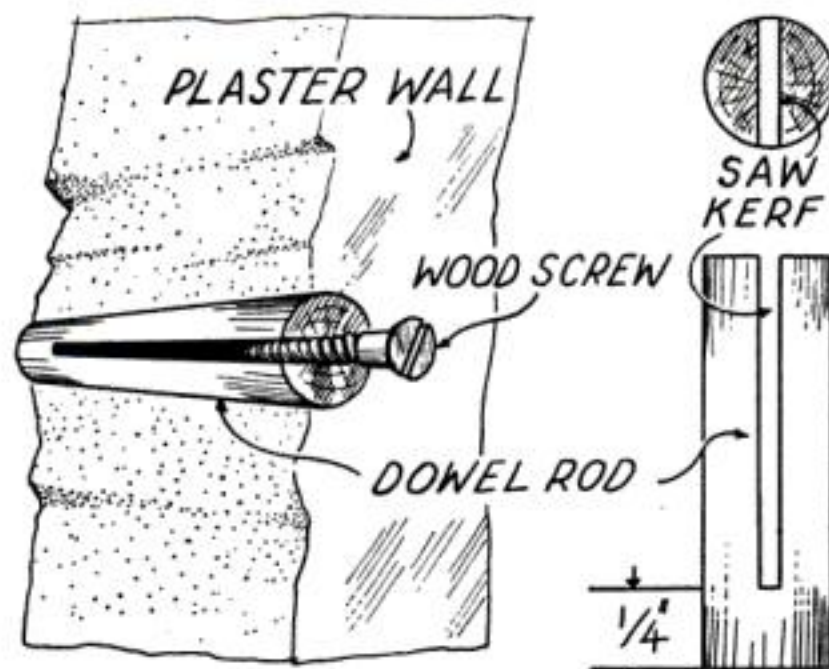


**OUT OF MOUSETRAPS?** I was recently, so I inverted a bowl on a 12" square board and propped the bowl on a thimble stuffed with cheese. When Mr. Mouse crept under to gnaw, down came the bowl. Board and bowl were then carried to a bucket of water, and the mouse was dumped in. It's a trap anyone can make.—MRS. CARRIE D. SMITH.

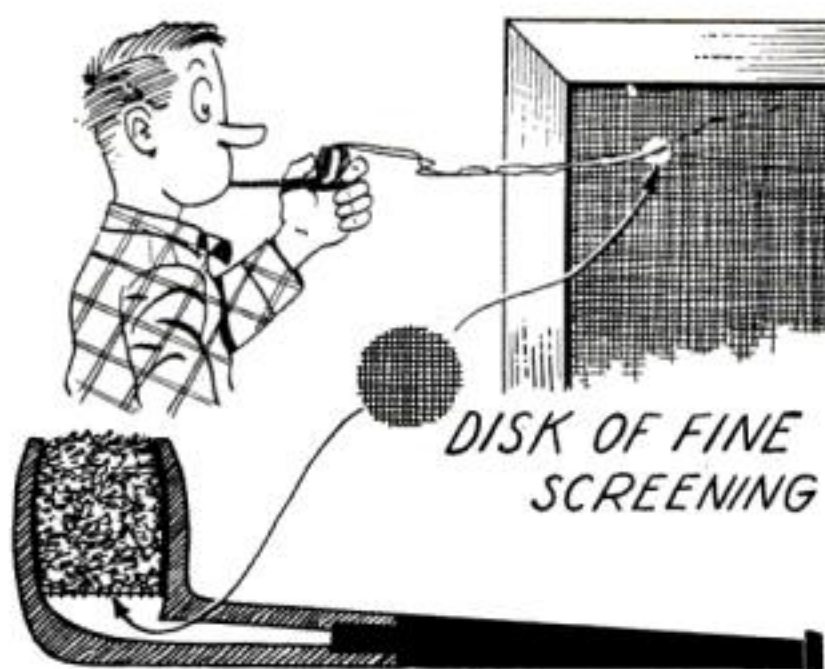
**NIGHTWORK STARTER** is what I call my device for getting up for my night-shift job without disturbing others asleep in my room. A slight electric tingle when the circuit is completed by the alarm key of a clock jars me out of my dreams. Difficulties: a sleeper who tosses may snarl himself in the wire; one who frightens easily may yell when shocked.—DAN ORLANDO.



**WITHOUT A TOGGLE BOLT** or expansion plug to my name and no time to dash out to the hardware store, I still got a bulletin board on the wall in time for evening school-shop classes. I used dowel plugs cut deep



with a saw. Driving a screw into the kerf expands the sides. The plugs hold as well in concrete and brick walls as they do in plaster.—HERMAN D. POST.



**SCREEN-FILTERED SMOKE** adds to my enjoyment of a pipe since I thought to cut a disk from a piece of screening and plant it in the pipe bowl. The disk prevents clogging of the stem by particles of tobacco and acts also as a grate to help keep the fire going. If you must take the disk from screening in service, stand by with the pipe so the smoke will make insects stay outside the house where they belong.—E. H. MORRILL.



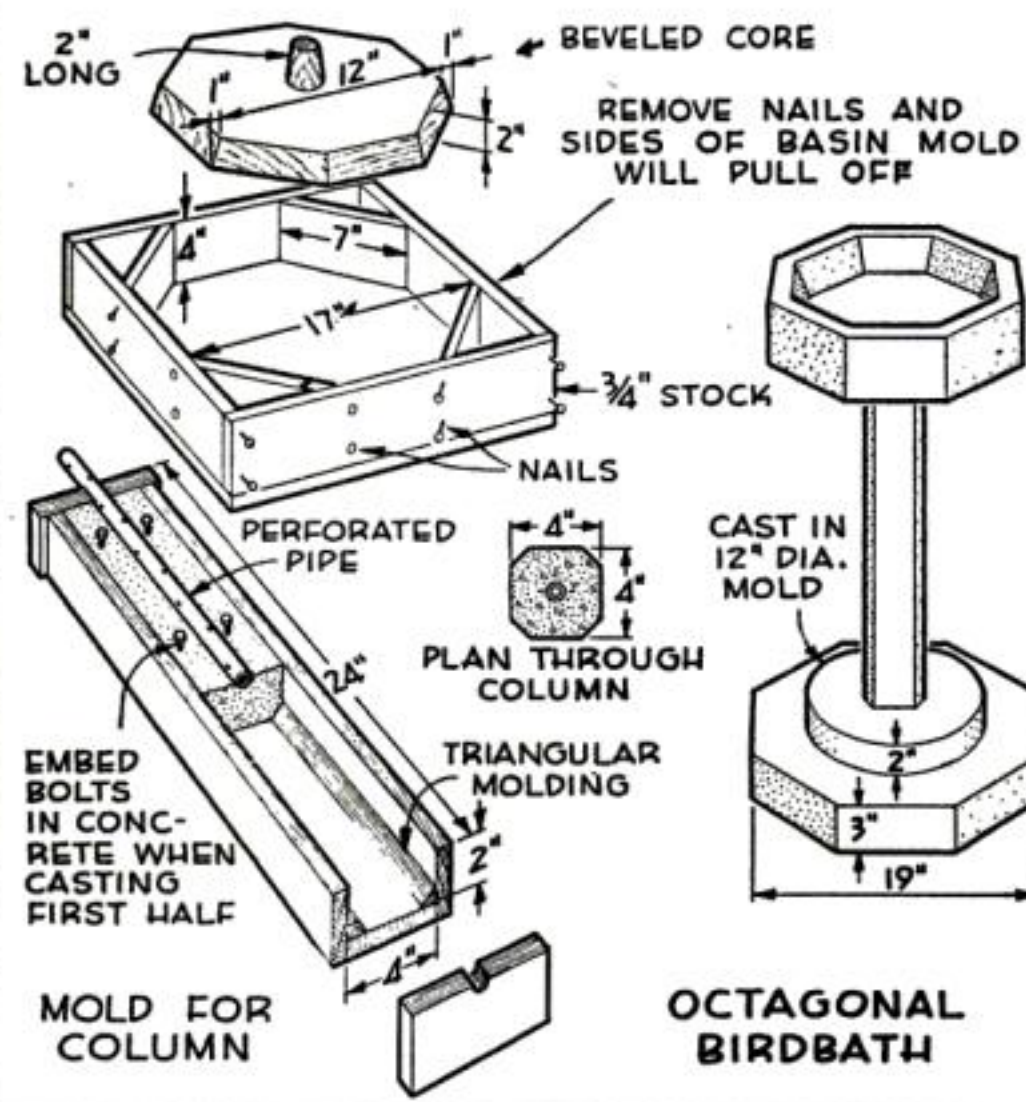
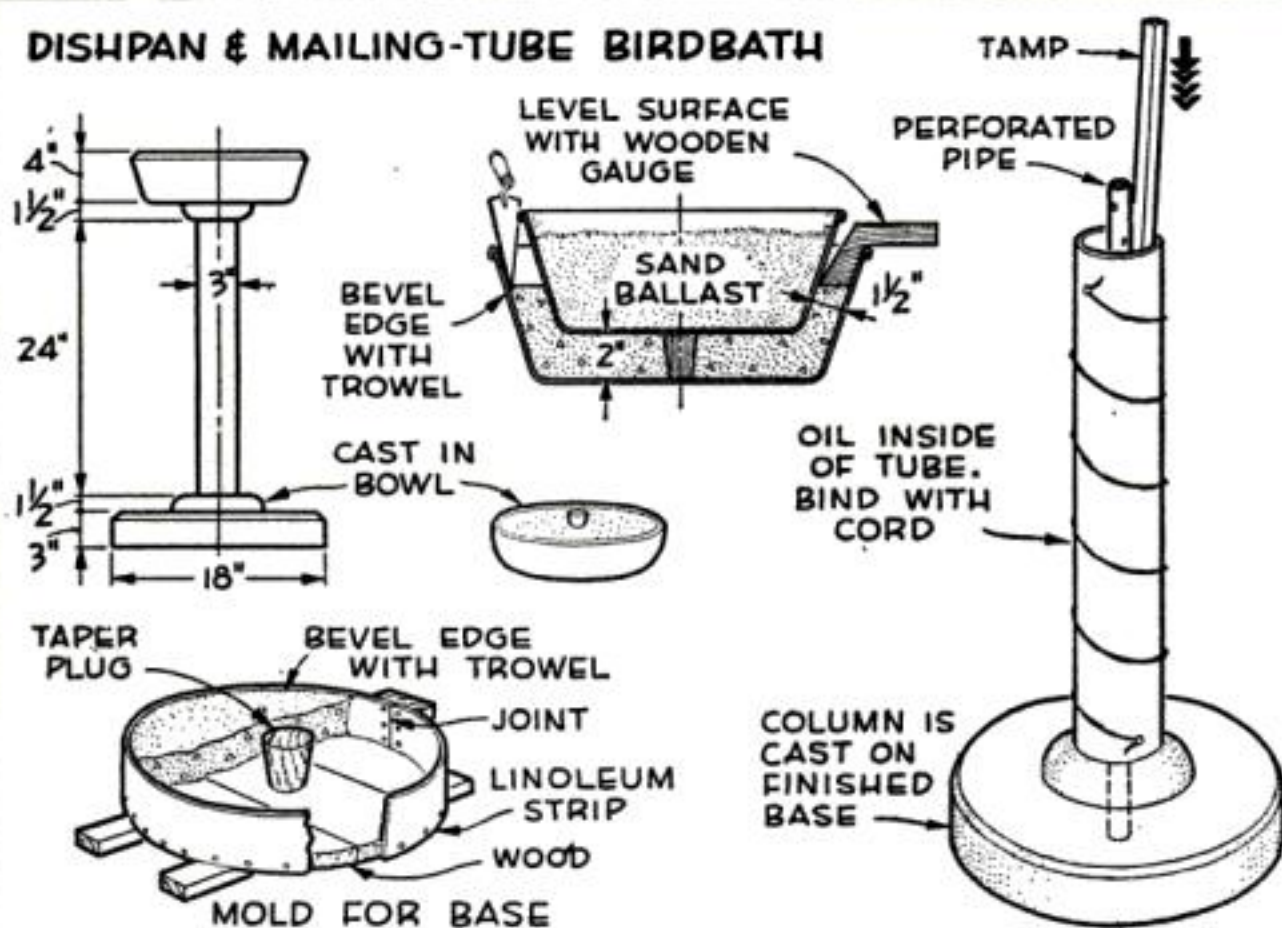


# CONCRETE BIRDBATHS

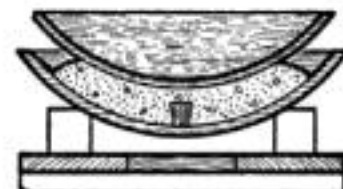
BIRDBATHS increase the charm of a garden or yard in double measure. They provide a focal point of interest in an open vista, and they lure feathered songsters that might not otherwise pay you a visit. Here are designs for two—with three optional methods of casting a circular basin.

Before mixing the concrete, have all the forms or molds ready. Dishpans of two sizes, a mailing tube at least 3" in diameter, a bowl, and a circular box made of wood and linoleum constitute one of the simplest methods of molding a bath. A small pipe, drilled here and there to hold the

## DISHPAN & MAILING-TUBE BIRDBATH

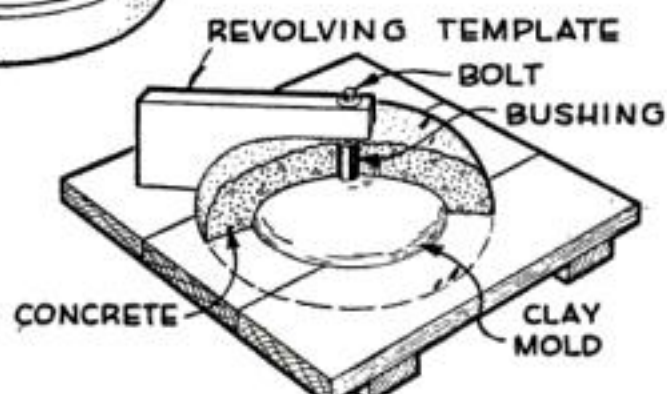


FORCE DOWN WITH  
A TWISTING MOTION  
TO TOP OF  
TAPER PLUG



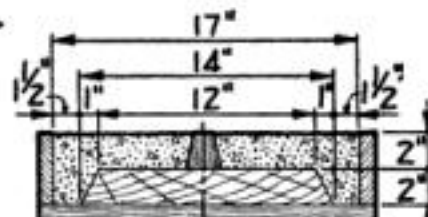
THREE-POINT CRADLE  
FOR BOWL

CHOPPING-BOWL  
BASIN MOLD



SHAPING A  
CIRCULAR BASIN

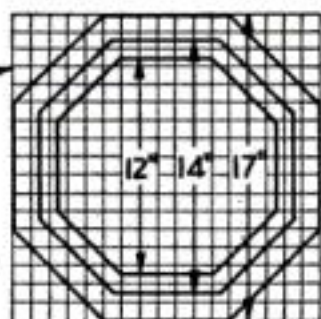
DIMENSIONS  
BETWEEN  
OPPOSITE  
EDGES OF  
OCTAGONS



SECTION OF INVERTED CASTING

1" SQUARES

HOW TO  
LAY OUT  
OCTAGONAL  
FORMS





# FOR YOUR GARDEN

concrete, adds necessary strength to the base and column. Removable taper plugs about 1" in diameter and 2" long provide holes in all circular pieces for this pipe.

Molds and forms for the octagonal bird-bath require more time to prepare, but aside from that it is just as simple. Cast the column in halves, embedding anchor bolts in the first and allowing it to cure before pressing down this half on the fresh

concrete of the second. Grease the inside faces of all forms for both baths before pouring the concrete.

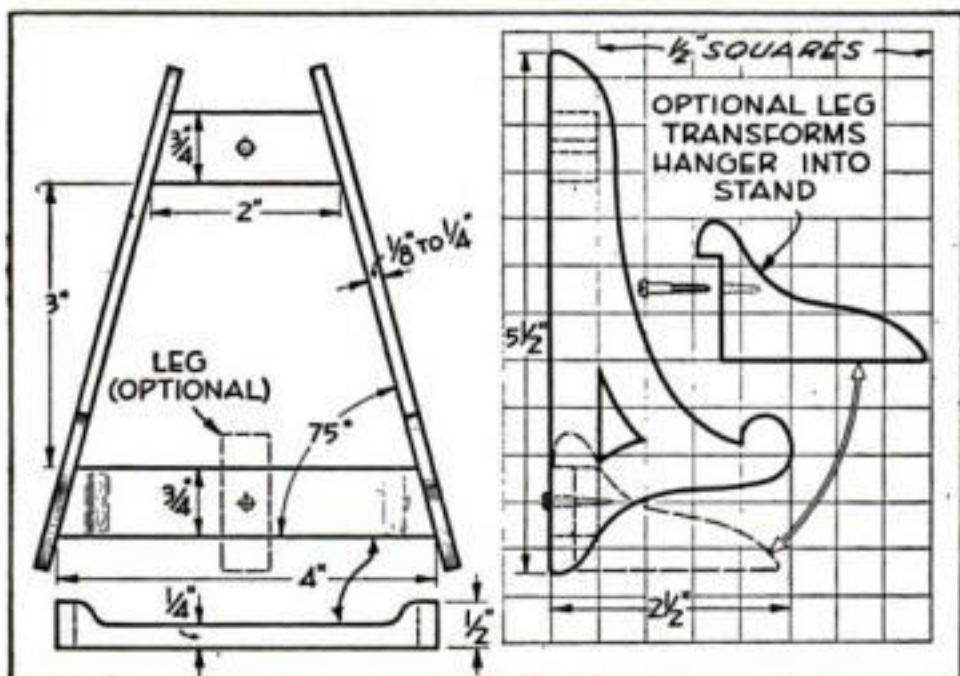
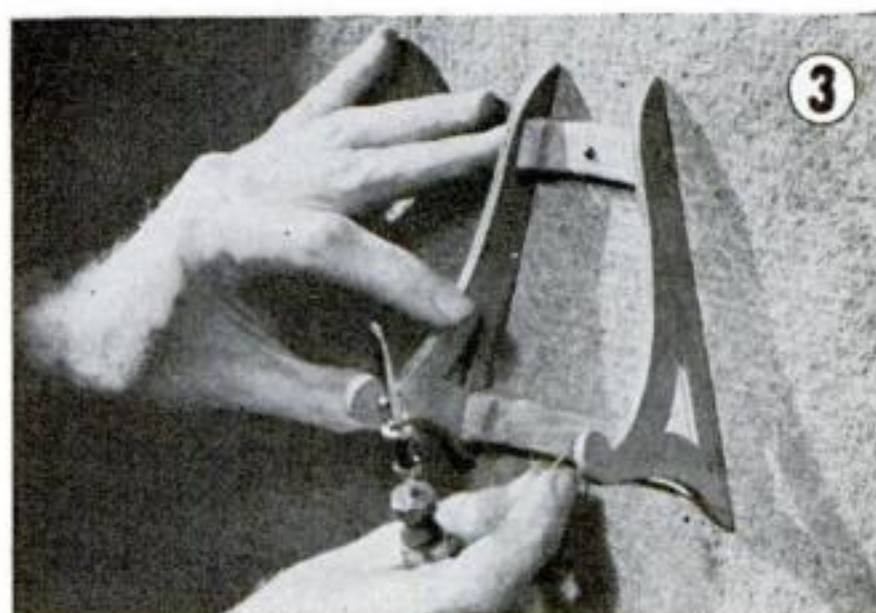
Recommended proportions of concrete for this class of work are 1 part cement,  $1\frac{3}{4}$  parts clean sand, and 2 parts fine gravel. Mix the sand and cement in a steel wheelbarrow, work in the gravel, and then add water slowly until the concrete has a plastic, but not mushy, consistency.—HI SIBLEY.

## INDIVIDUAL RACKS DISPLAY PLATES TO ADVANTAGE

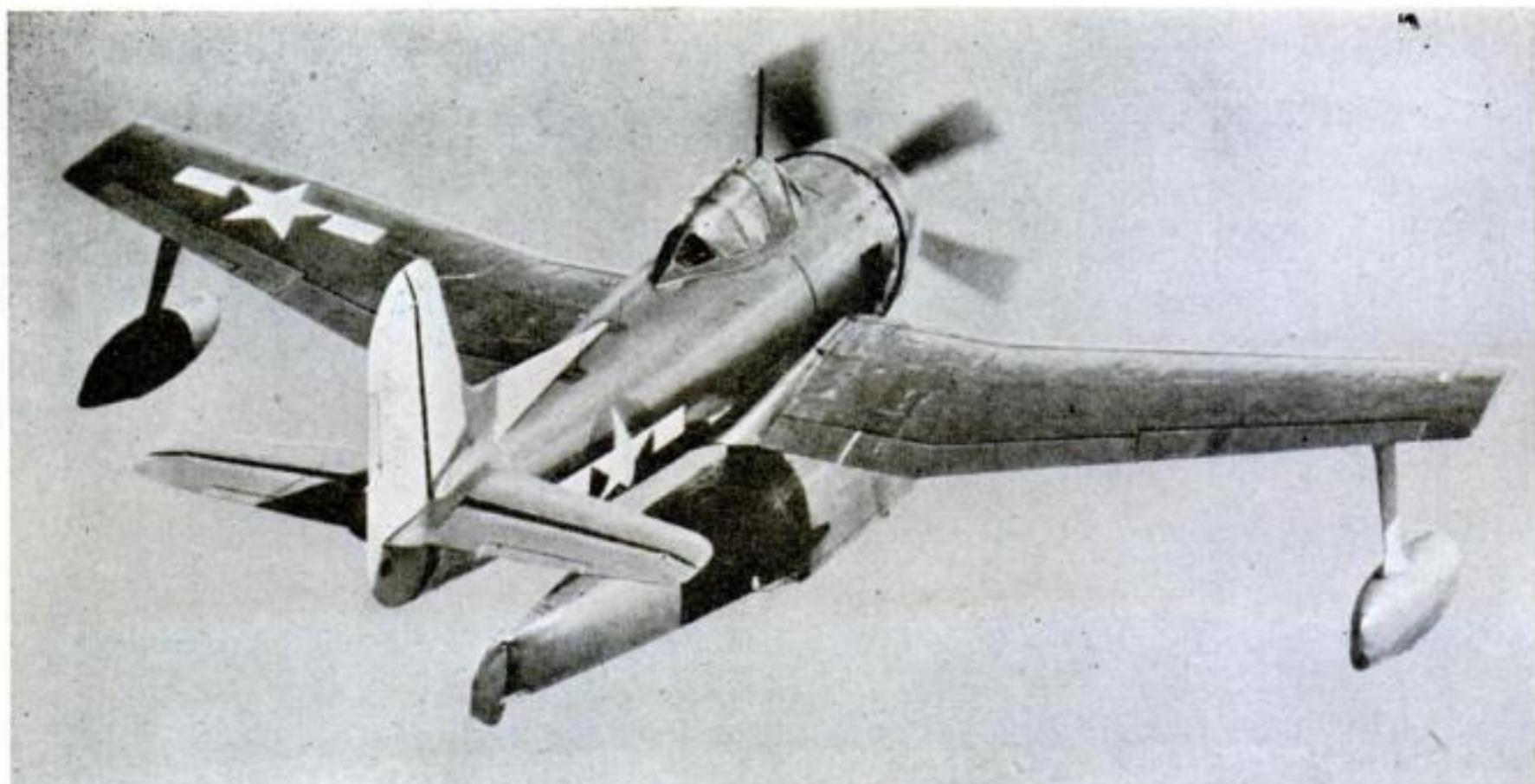
INDIVIDUAL wooden wall racks offer a pleasing way to display decorative plates. A rack such as that shown in use in Fig. 1 is suitable for plates 6" to  $8\frac{1}{2}$ " in diameter, and should require only an hour or so of the average craftsman's time. As indicated in the drawing below, the rack can be fitted with a leg that will convert it into a stand for use on a shelf.

Two sidepieces may be cut simultaneously from plywood  $\frac{1}{8}$ " to  $\frac{1}{4}$ " thick. Sketch the side profile of the rack on one piece of material, then fasten this piece to another by driving brads through waste areas. Jigsaw out the triangular opening, and then cut the outline.

Strips measuring about  $\frac{1}{2}$ " by  $\frac{3}{4}$ " are excellent for the two cross members. Cut the ends of these on an angle of about 75 deg. The crosspieces, especially the lower one, will look better if the thickness is reduced to  $\frac{1}{4}$ " for most of the length. Fasten each joint (Fig. 2) with glue and two small brads. Drill holes in the crosspieces to receive mounting screws (Fig. 3). Set all nailheads and fill the holes before applying the finish you prefer.—W. E. B.







Because of its speed and maneuverability, the Navy expects the Seahawk Scout to hold its own in combat.

# AERIAL EYE OF THE FLEET

By PAUL PLECAN

**L**ATEST in a line of famous scout-observation planes, the Curtiss Seahawk is fast replacing the older and battle-weary Kingfishers and Seagulls that have served the Navy so magnificently. Capable of flying faster, higher, and farther than any previous Navy scout plane, the Seahawk mounts two large-caliber guns in the wings to keep itself out of trouble. This single-seat, single-float, low-wing seaplane develops nearly three times the power of earlier models; it has a nine-cylinder engine and a four-blade propeller. Measuring 36' 5" in length, the Seahawk has a span of 41'.

As with the previous planes in this series,

modelers will find all the necessary details and measurements on the accompanying scale drawing. No templates have been laid out for the canopy, however, because of the difficulty involved in working with such small sizes. After carving the cockpit in the fuselage, fashion the canopy out of small strips of celluloid by the "cut and try" method and cement it in place.

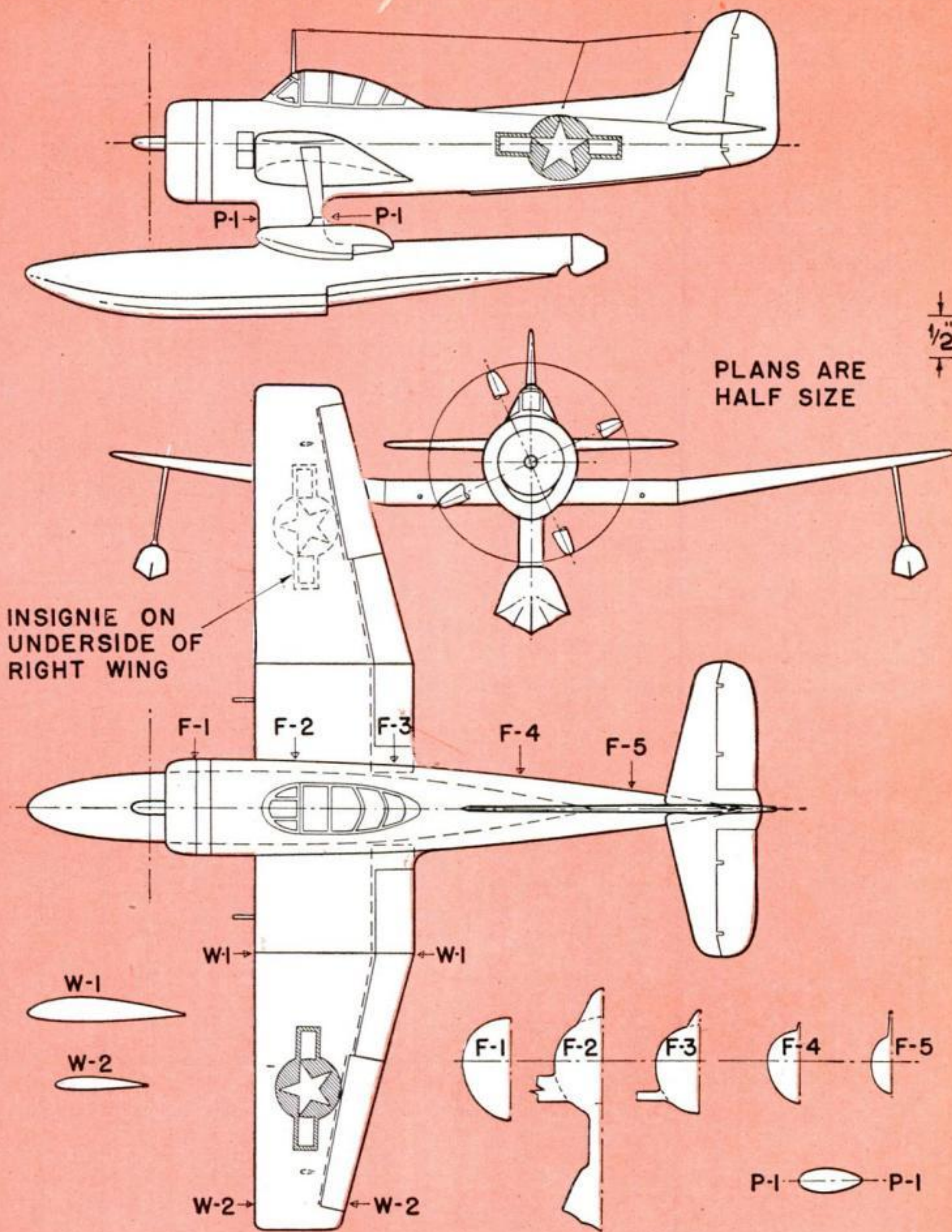
Sand the scalloped underside of the float and cement the unit to the streamlined pylon which is, in turn, cemented to the fuselage. The thin keel strip under the rear half of the fuselage can be simulated by a length of wire carefully cemented into place.

To give your models a slick appearance, use wood filler, but let it dry thoroughly before sanding.

You must look closely to tell the real plane from the model. Below is an actual Seahawk in flight.







CURTISS SEAHAWK SC-1

P  
P



## Soldier Builds Boat from Two Gas Tanks of Fighter Plane

TWO discarded gasoline tanks from a P-38 Lightning, an air-compressor engine from a salvage yard, and a few scraps of metal gave Sgt. Donald E. Hudson, of DeKalb, Ill., all he needed to build a two-seater power boat. He cut the top of each tank away, welded the pair together by means of connecting bars, mounted the motor between, and formed a propeller of the scrap.



## Tiny Piano Formed from Plane Scrap by Hospital Patient

AIRPLANE scrap was used by a patient at the U. S. Naval Hospital in Long Beach, Calif., to make the miniature piano below. The piano consists chiefly of pieces of clear acrylic plastic salvaged from the nose of a plane. A music box inside provides tunes.



## Former Marine Produces Many Types of Model Airplanes

BORROWING \$500, Albert M. Wildt set himself up in business some time ago as a manufacturer of model airplanes. Now, as owner of the Falcon Model Airplane Company, of Long Beach, Calif., the 33-year-old former Marine finds a steady demand for his products. Above, he holds one of his favorite models—a tether-controlled speedster powered by a single-cylinder gasoline engine, which, he reports, has propelled the model at a top speed of 133 m.p.h.

### *Your Dream-Boat Design May Win \$250 Bond*

**D**O YOU plan some day to build or buy an ideal boat? If so, your ideas may be worth money. For the best designs for boats not more than 35' long, *Popular Science Monthly* will award a \$250 war bond as first prize and an equal sum in 15 lesser prizes. Entries must be postmarked not later than November 30, 1945. For full details of the contest, see Page 172 of the September issue of *Popular Science Monthly*.



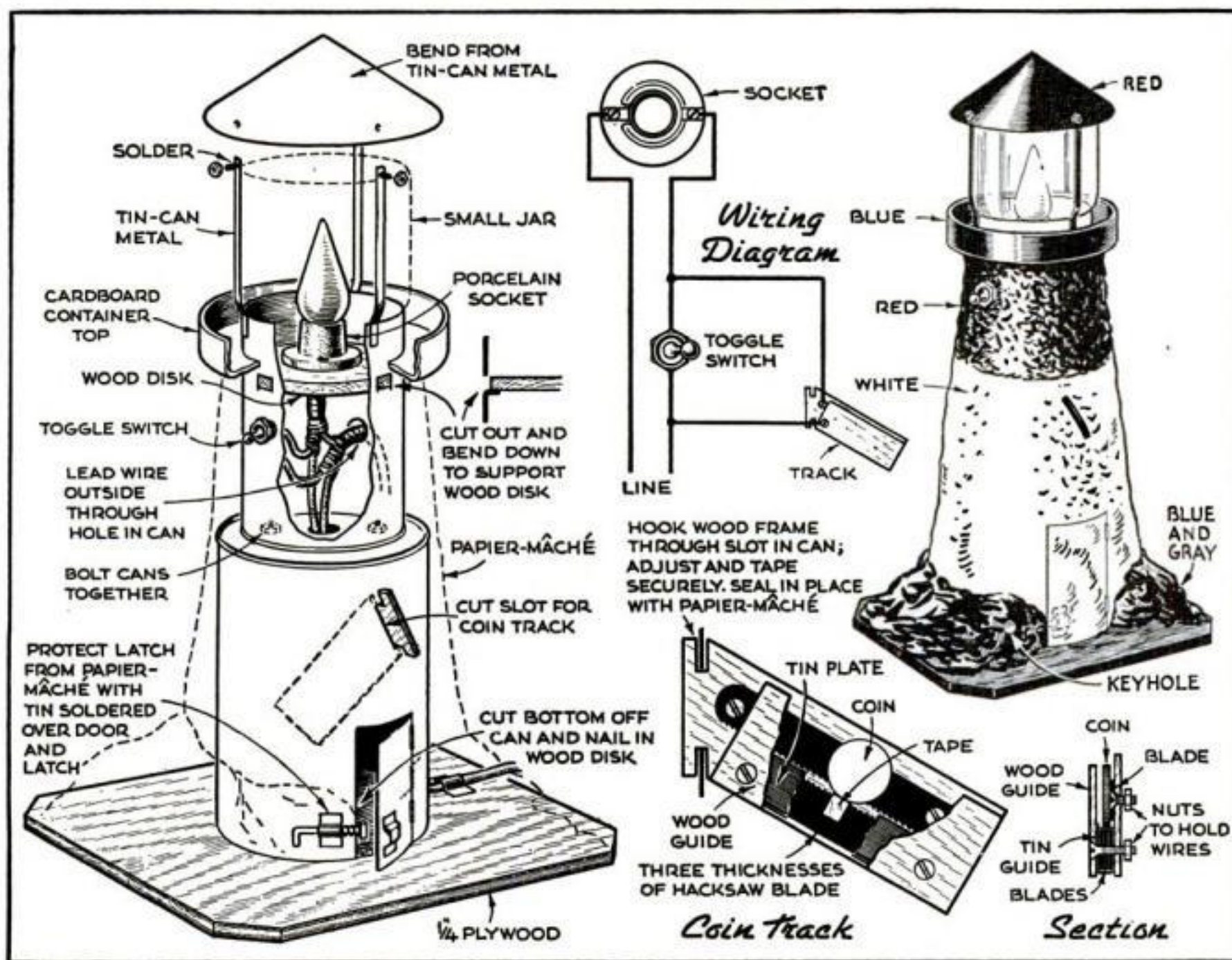
# LIGHTHOUSE BANK FLASHES FOR EACH COIN

**A**CTION-MINDED kids who won't drop coins into piggy banks unless they hear 'em squeal will find all they're looking for in this lighthouse coin-catcher. The light blinks three times for every piece of change that hits the rocks.

One tall tomato-juice can and one smaller one make up the structural framework of the tower. The electrical equipment consists of a coin track, a lamp socket, and a switch, wired as shown in the diagram. Since the switch jumps the coin track, the 110-volt light can be turned on and made to double for a night lamp. To make the coin track, bend a piece of tin-can metal around the top and sides of three hacksaw blades and clamp all between two strips of wood. Screw another blade fragment to the inside of one of the strips so that electrical contact will be completed when a coin rides down the track. Masking two parts of the track with tape will cause the light to flash.



Cover the frame completely with papier-mâché. Insert a nail through the soft papier-mâché base to the latch hook. The hole it leaves will be practically invisible but will enable you to unlock the door with the help of another nail.—JOHN SCHUSTER.





# HIGH-RELIEF PANEL CARVING

**W**ITH its bold figures standing well out from their background, high relief takes panel carving well into the realm of sculpture. Whereas low-relief carving involves only slight depth between planes, high-relief work commonly uses ornamentation or figures that are more nearly formed "in the round" and that approach the likeness of full-figure carving. Such woodworking is modeling in the true sense.

High-relief carving adds to the grace of well-executed low relief the charm of high lights and dark shadows and a flow of tones over surfaces ever-changing in direction. Wrought from solid wood, it expresses the creative bent of the workman and his skill with tools.

Select well-seasoned wood of a thickness sufficient to leave a substantial backing after the ground has been deeply sunk. If a door panel, such as that illustrated, is the project to be carved, fit it to the frame before taking any other steps, as portions carved thin may later render it fragile.

*What are the first steps in carving?* The procedure shown in the accompanying photographs is typical. Transfer the pattern to the workpiece, clamp the work with the bench vise, and lay out the chisels in orderly array so they will be conveniently

at hand while the modeling goes forward from one part to another.

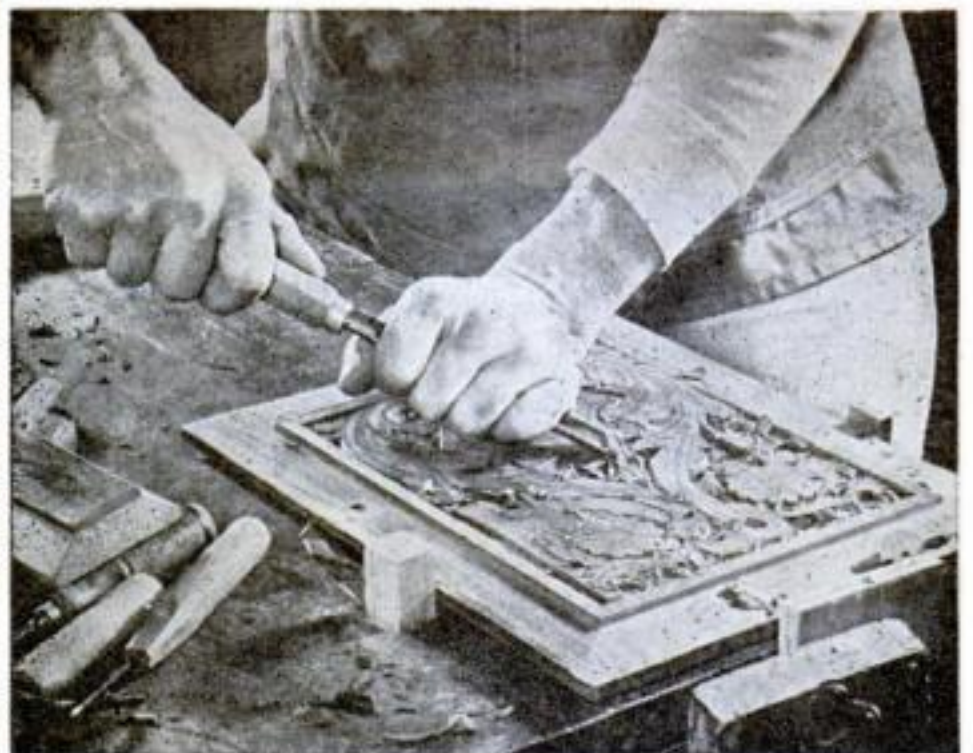
Outline, that is "firm in" the raised part with tools most nearly fitting the curves and by making use of a narrow, flat chisel where convenient. Hold the tool in a vertical position with the edge slightly outside the line and strike it with the mallet just hard enough to sink it well into the wood. If the wood crushes back of the line, strike lighter blows.

In working the panel shown, ignore the notches in the edges of the leaves during the outlining. Bevel the waste wood to the line and, if the depth is not sufficient, go around a second time with vertical cuts. Rough down the ground with gouge cuts made diagonally and with the grain, or rout it by machine. Outline the flower centers with a  $\frac{1}{2}$ " gouge in two or three stages to prevent splitting off of the "pearls," that is, the small domes.

*Does modeling come next?* The next step after the firming in has been completed is "bosting"—literally "sketching." It is a broad over-all shaping of the design in which the surface of the raised part is roughly carved to the dips and rises of the finished work, establishing the general rhythm in the third dimension.

*How can a drawing guide modeling?* An inexperienced craftsman can avoid uncertainty by modeling half the design in clay or soap according to the drawing, and reworking it until it seems right. With this to follow, he can carve with assurance and greater speed.

With a large gouge, left, the ground is cut both diagonally and with the grain. Spirals are cut below with a gouge. A flat chisel is often used.





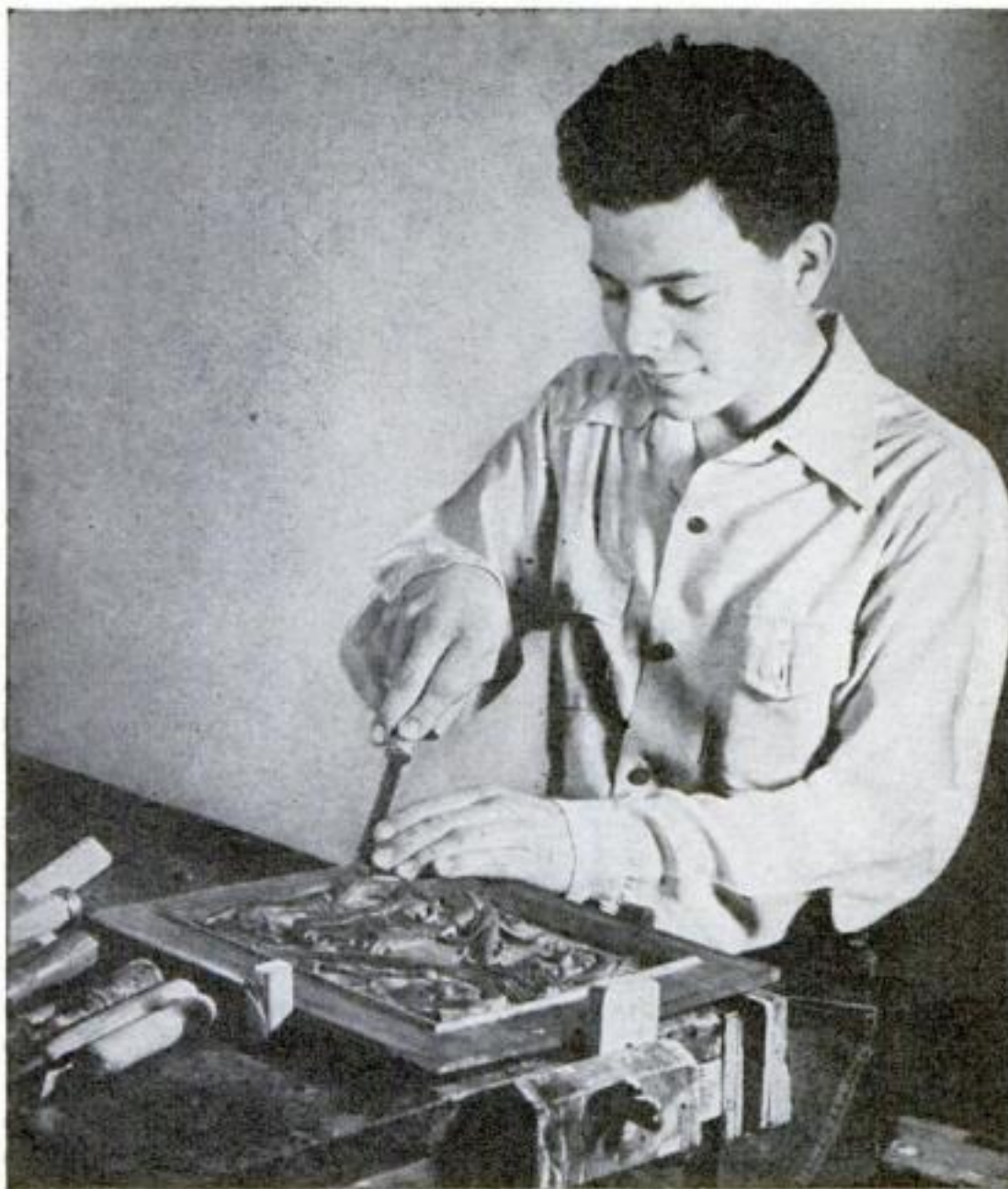
By  
**EDWIN M. LOVE**

*Doesn't bosting destroy guide lines?* Yes, many of the lines are lost and must be redrawn on the new surface before further carving can proceed. If desirable, they can be saved by shallow firming in or by scoring with a V-tool before the bosting is started, but care must be taken not to cut so deeply that the marks cannot be removed with chisels and gouges in the course of carving. Safeguard the delicate tendrils by outlining them in club-shaped masses to give them strength to stand up during the bosting.

*Is there a general plan of modeling?* There is such a plan. The cartouche or scroll forms a thick mass from which stems and leaves spring. As the leaf clusters divide, the level falls. The stem rises again as the clusters grow over the background leaves, and sinks beyond to the ground. This cycle is repeated along the upper stem. Upon the rhythmic grace of these lines depends much of the quality of the carving in the finished work.

*How is detail carving handled?* Outline the center boss of the cartouche with a V-tool and carve the sides with a flat chisel to form a sort of gable with convex sides. Roll the three scrolls toward the ground and slope them inward toward the boss with

Light pressure and a twist of the gouge will keep delicate work from crumbling during trimming such as that of the inside of the tendril curve below.

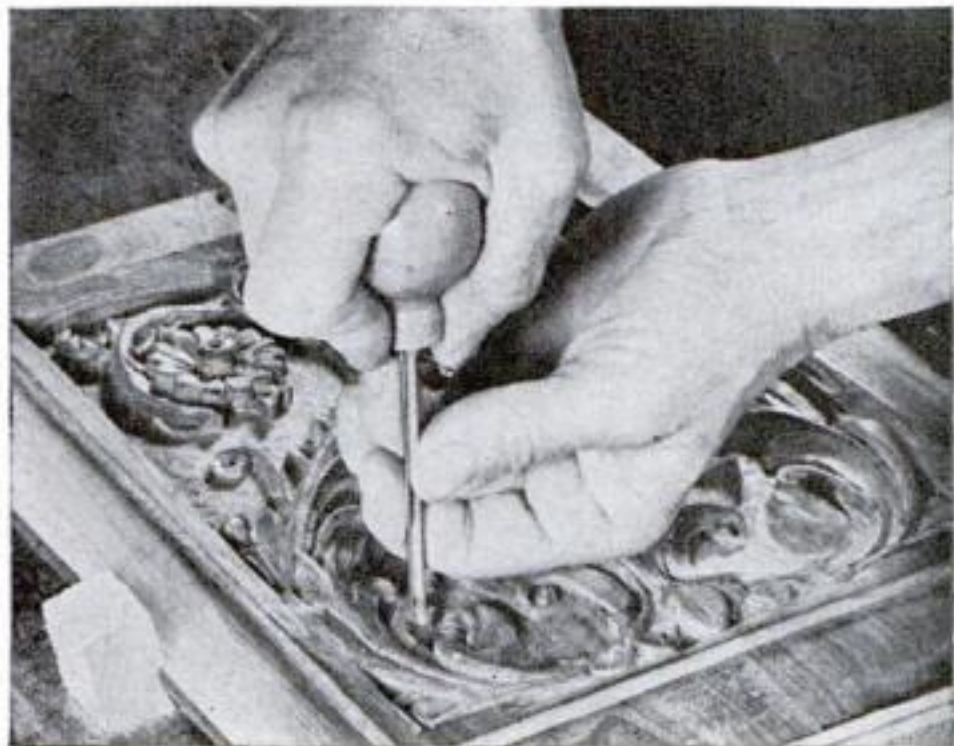


Shearing cuts with a flat chisel bevel the border of the panel, reducing apparent height so leaves may roll over it slightly.

a flat chisel; then hollow the scrolls at the centers with a gouge. The coved edges, carved from both ends, sweep down toward the ground and coil over the scrolls, continuing as beveled edges of the spirals.

To insure a strong shadow under the cartouche, dip the lower portion nearly to

Use of a narrow, flat chisel is often convenient. Such a tool is employed here in beveling the edge of a stem. These chisel cuts are long and clean.





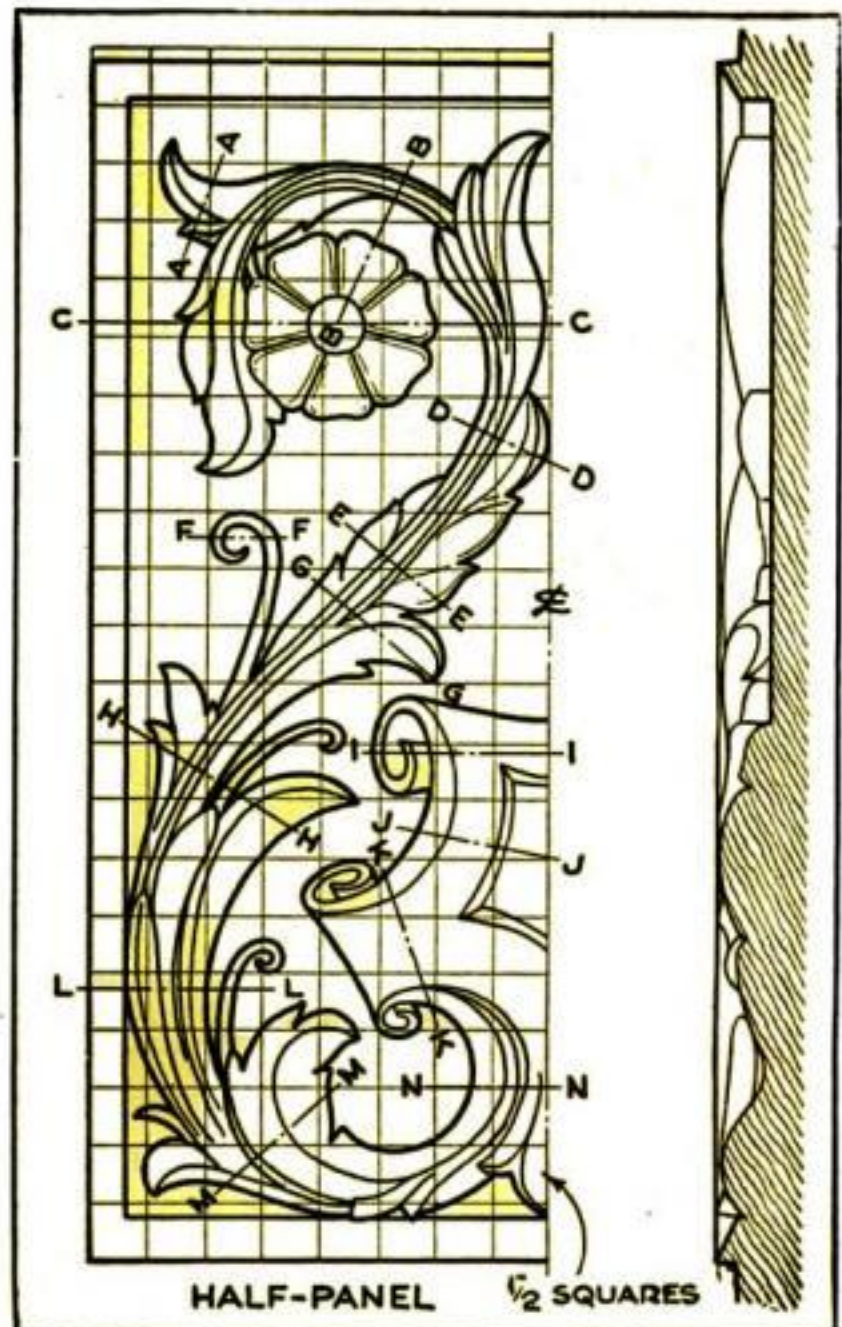


Above, a spoon skew is found handy for working in the corners while touching up the ground. Below, a wide butt chisel is used for straightening the border. The edge is rocked down from one corner.



the ground and swing the side flutes into the leaves. These leaves flow around the stems, dipping over the background and curling up at the tips. The upper leaves, showing their backs, have sharp-edged center ribs. Their sides slope away and are hollowed distinctly with gouge cuts. The under leaves, on the other hand, expose their faces and are cupped.

*Why aren't stems and tendrils rounded?* Stems are traditionally square in section in



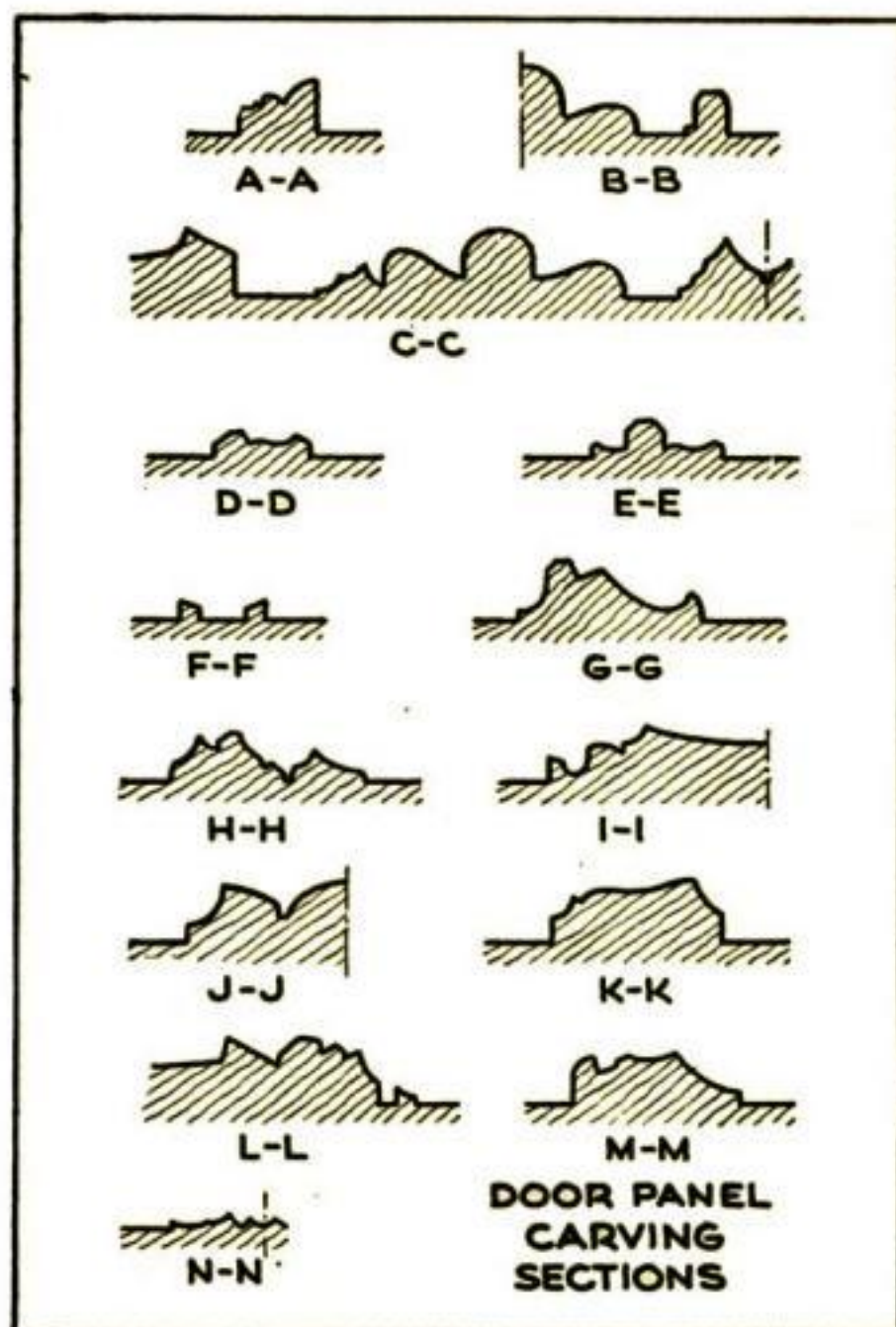
many types of strongly modeled carvings. In the design shown the corners are chamfered, a treatment that lends strength and snap to the design. The leaves are tangent to the stems, and the stems, emerging from leaf clusters, are flat on top, assuming octagonal form as they rise over the under leaves. Their chamfers become the modeled sides of the leaves. Tendrils slope downward toward the ground and are carved with tops beveled toward the inside of the curves.

It is not necessary that members of a pair be exact opposites, for one on the left side may spiral uniformly downward toward the tip, while its mate dips and rises again. So also with the leaves. Small variations can be introduced, designed with care and appearing purposeful instead of seeming to be the result of carelessness.

*How are the flowers carved?* Shape the petals as circular pads dipping at the centers and rolling toward the ground at the tips. The outer edges rise because they are lying on the leaves. Separate them with a V-tool and hollow them with a gouge. Round the "pearls," keeping them almost at the full height of the piece.

*What are the finishing touches?* Complete the leaves by cutting in the edge notches and trimming up the modeling. True the edges with clean vertical offsets





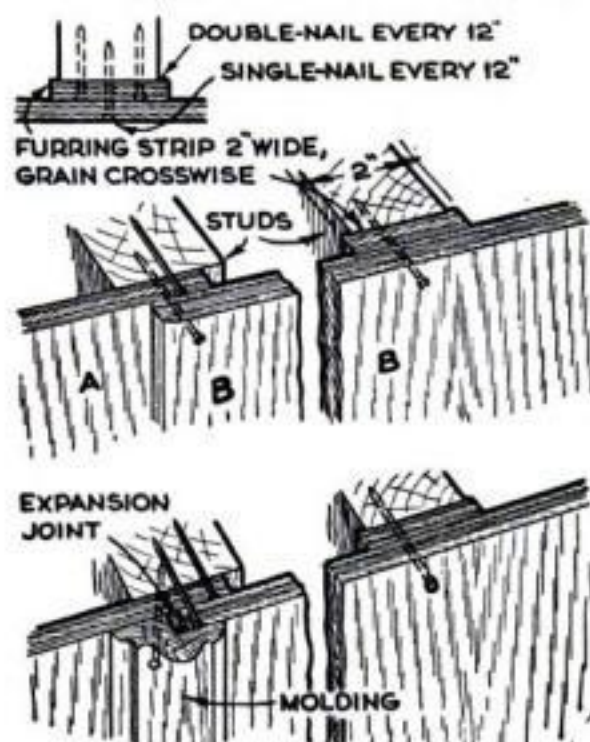
And here is the completed panel. Sections at the various points in the design are shown at left, keyed for reference to the half-panel design in the plan and profile drawings on the facing page.

that cast outlining shadows. Note how the inside leaves above the cartouche turn outward and slightly over the stems, emphasizing the curve at that point. Touch up the sides of the stems, especially where they join the under leaves. Lessen the apparent height of the border by beveling it inward, allowing in the process a slight roll of the leaves over the inner edge of the border.

The finished effect of the carving should be that of long, free strokes. Do not attempt to plane the surface to smoothness. Leave sandpaper strictly alone. Much of the charm of a high-relief carving of this nature depends on the tool marks—not scratches or rough spots made by careless cutting against the grain, but the prints of clean, purposeful gouge work.

## LAP-JOINTING PLYWOOD WALLBOARD

[ WOODWORKING ]



Raised panels with lap joints simplify installation of interior plywood wallboard. Vertical joints are made on studs, while horizontal joints are put on girts consisting of blocks nailed between studs on a level line. Nail panels **A** directly to the studs. Fur the remaining studs with 2" plywood strips cut with the grain of the outer plies running crosswise. Nail sheets **B** in place. The edges may be left square, beveled, chamfered, or rounded. Since the nails spring, this method allows for slight movement of the frame from shrinking and swelling.

Sheets **B** may be glued at the joints and on the furring strips. Apply a heavy enough coat of thick casein glue to squeeze out at the edges, and nail in place. Scrape off the squeezed-out glue and, if a stained or a natural finish is to be applied, carefully clean with a damp cloth, as the glue itself will stain and also will prevent other stains from penetrating. Since gluing precludes joint movement, expansion gaps must be provided at openings, ceilings, floors, and if possible at corners.

To apply moldings to a joint, nail the plywood in place and hide the nailheads with a rabbeted molding nailed over the lap.

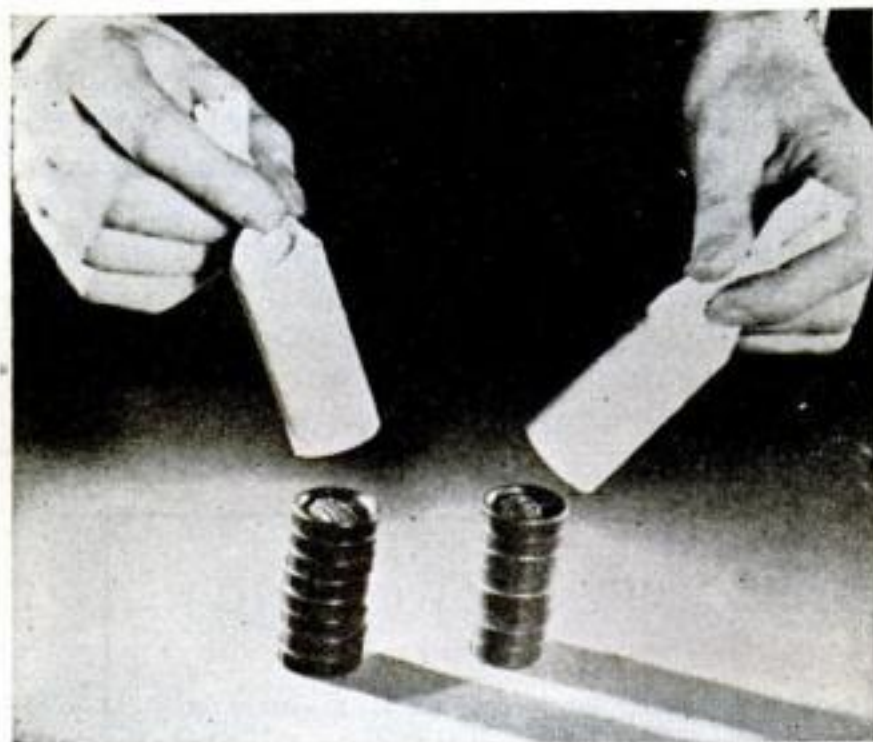
POPULAR SCIENCE MONTHLY SHOP DATA





**FIRE CARRIED IN YOUR HANDS** will astonish guests at dinner. When they are taking their seats light one candle in the ordinary way; but then let the match go out, and discard it with a remark that you don't need a match anyway. Cup your hands, hold them over the candle flame, pick up a light from it, and carry it ostentatiously to the remaining candle or candles.

Sound hard? It won't require superhuman powers if you have a headless wooden match stem concealed between the two middle fingers of one hand! To extinguish it eventually, blow as if to cool your hands.



**CHECKERS SWAP COLORS** in this trick which, however, you can't work against an opponent during a game. Stack six or eight in two piles, one red and the other black, and then cover them with rolled tubes of paper twisted at one end into a handle.

Shuffle the piles, lifting them occasionally so no one can miss seeing the exposed bottom checker. Then set them down and ask someone to tell the color of each pile. If he has been observant, he will be wrong! For the bottom checkers will fool him. The underside of the black is painted red, that of the red painted black.

**SHRINKING A HALF DOLLAR** so it will slip through a hole the size of a nickel isn't much of a stunt in theory nowadays. It can be done physically as well! Cut a hole in paper and let your friends try first. They will give up soon enough, and when they do, show them how. Crease the paper through the center of the hole, fold it, and then work the crease inward and upward, as indicated in the photo below. This stretches the hole so the half dollar will fall through.



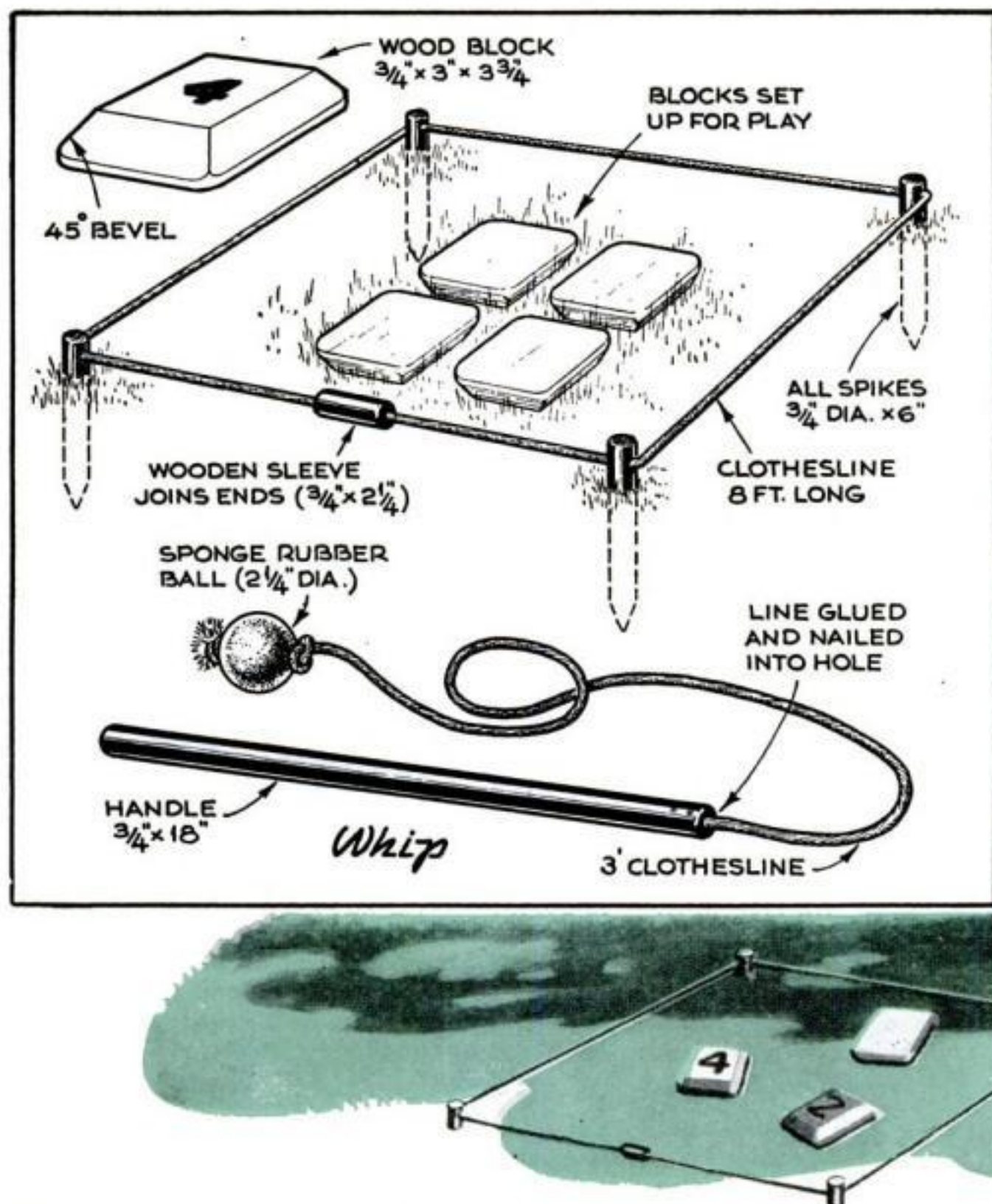
**KINGS ARE CLUBBY**, even those of spades, hearts, and diamonds. Distributed in a deck of cards, they turn up together—if you do the necessary stacking!

Exhibit four kings fanwise; then put them on top of the deck, take up the top card, show it to be a king, place it on the bottom of the deck, and take off the next two one at a time and insert them anywhere in the pack. Now, have someone cut the deck and then look through it. All four kings will be together again!

Here's why. Behind the second king right at the start are secreted two other court cards. They won't show if you hold the fan carefully when exhibiting it.







## Whip Makes Blocks Fly in Lively Lawn Game

By MYRON FLEISHMAN

**Y**OU have played games with balls, bats, rackets, darts, and marbles, but the chances are you have never played one with a whip. This is a real action game for both grown-ups and youngsters—the latter not necessarily on the receiving end.

Drive the four pins into the lawn to form a 24" square with the clothesline taut about 1" off the ground. Then place the four blocks in the center with their numbered sides down—you can tell their value by the color, which should be different for each.

Each player takes a turn, standing off from the square and whipping down at the blocks in an effort to turn them over. They will fly high if hit near an edge. If they stay in the square when turned over, the numbers count double; if they flip outside, just face value counts—but only if they land numbered side up. Any block can be

whipped repeatedly as long as it stays in the square, but once it lands outside it can't be touched again and won't count if the numbered face is down.

Bevel the edges of the blocks as shown in the drawing so they will be easier to turn over. Use an 8' clothesline for the square and join its ends by gluing them into a wood sleeve and pinning with brads. The length of the whip may be that most suitable to the players. Glue and pin one end of a length of clothesline into a 2 1/2" deep hole in the end of the handle; then thread the other end through the hole in the rubber ball and knot it.

The game is strictly one for outdoors. Even if you could arrange a square for a floor, the blocks would fly too high for comfort. They will also fly uncomfortably high if you play on hard ground.





# Seven Steps to a Handmade KNICKKNACK SHELF

By Charles and Bertram Brownold

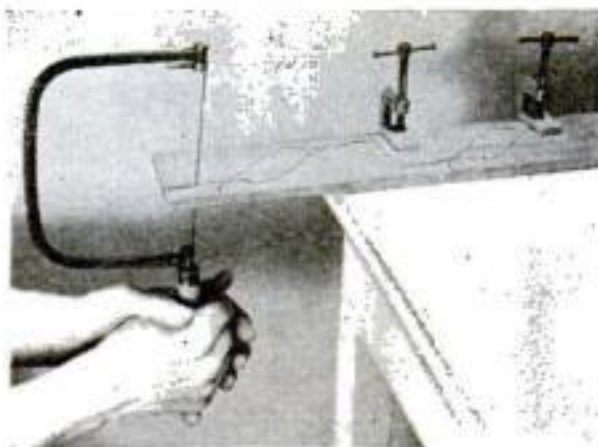
THIS ornamental shelf, ideal for displaying small decorative objects, may be made with the simplest hand tools. As the photos show, not even a workbench or vise need be used, since a kitchen table and a C-clamp jig serve as satisfactory substitutes. The simplicity of construction makes this a pleasant one-evening project for those without access to regular shop facilities.

No screws show on the completed shelf, which is held to the wall by means of four screws, their heads covered as shown at the left by ornamental upholsterer's nails. The stock,  $\frac{3}{8}$ " or  $\frac{1}{2}$ " thick, should be capable of a fine finish.



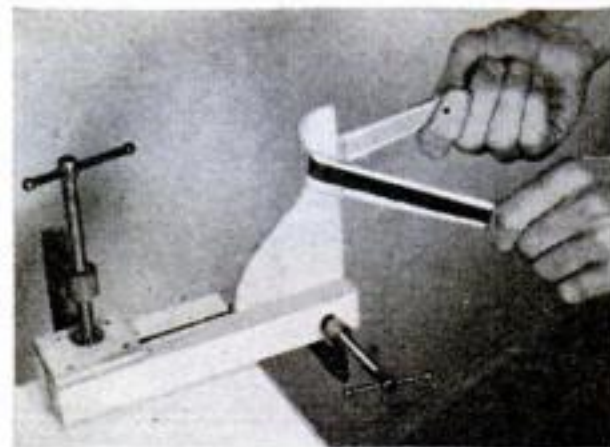
Make cardboard patterns; then arrange the layout for minimum waste, especially if fine wood is used. Watch grain direction.

Drill for a  $\frac{3}{16}$ " or  $\frac{1}{4}$ " dowel exactly  $2\frac{3}{8}$ " from the back of the bracket, as indicated by the dotted line in the drawing.



With the wood clamped to a table the eight pieces are cut to size with a coping saw. Too much overhang in sawing will cause chatter.

Then drill the shelves for dowels on the underside  $2\frac{3}{8}$ " from each notch and 3" from each side edge. Tape the bit for a  $\frac{1}{4}$ " depth gauge.

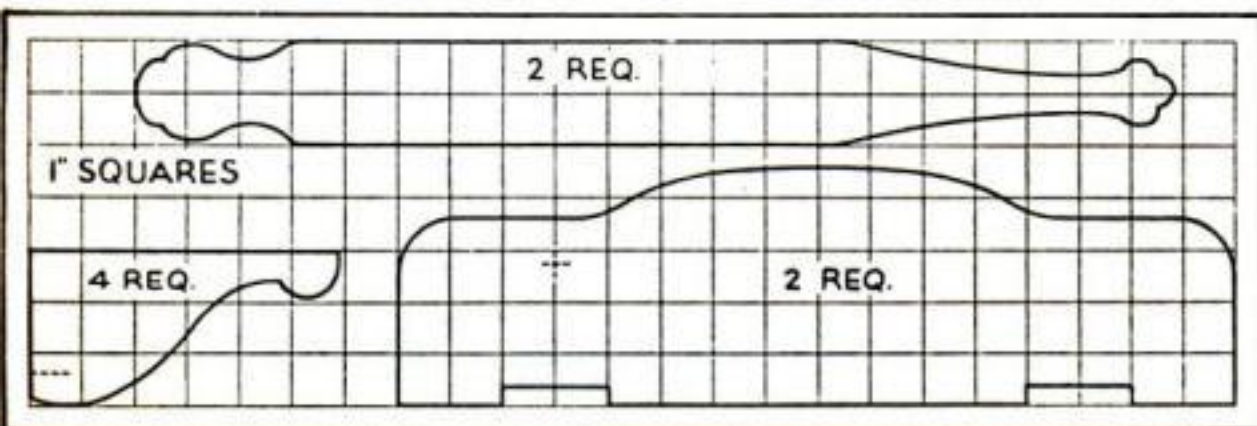


This jig clamped to the table for a vise holds a part as its outer edge is sanded round with a strip of sandpaper reinforced with tape.

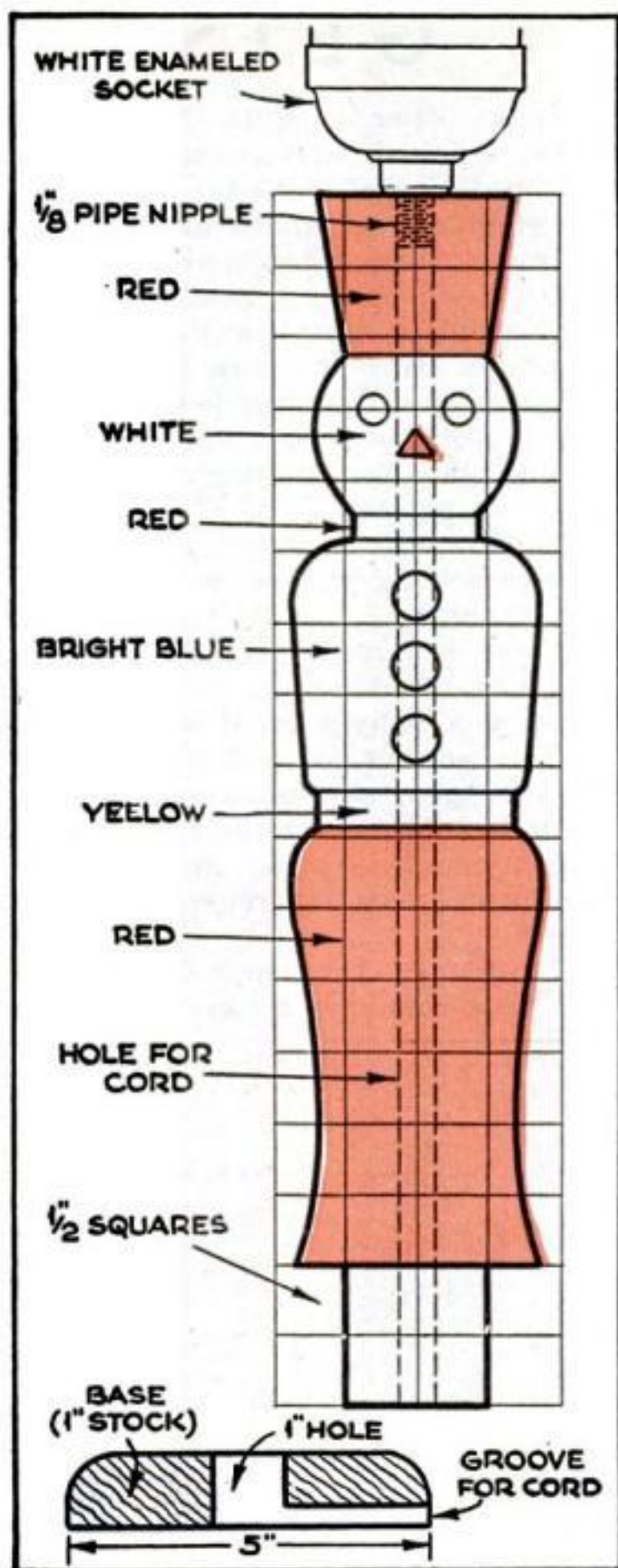
Drill the two vertical members and countersink the holes in the back, glue dowels into the brackets and shelves, and assemble with screws.



Shellac thinned with alcohol is a good finish for mahogany and other cabinet woods. Apply three coats, rubbing after each with fine steel wool; then polish well with wax. Use paint or stain on soft woods.







## WOODEN-SOLDIER BEDSIDE LAMP IS QUICK TURNING PROJECT

BRIGHTLY decked in red, white, blue, and yellow, this toy-soldier lamp will be a delight in any child's room. The soldier is turned from hardwood, and the hole for the cord is bored from both ends to meet at the middle. Cement into the top end a pipe nipple on which to screw the lamp socket. Turn the base, bore it to receive the lower end of the soldier, and cut a channel in the bottom for the cord.

Eyes, nose, and buttons may be upholsterer's nails driven in or rivets cemented into small, drilled holes. File the nose to a triangle.

Apply three coats of a good grade of white enamel to the base, sanding between coats, and enamel the figure in the colors indicated. If the buttons are left brass, clear lacquer will prevent tarnish.

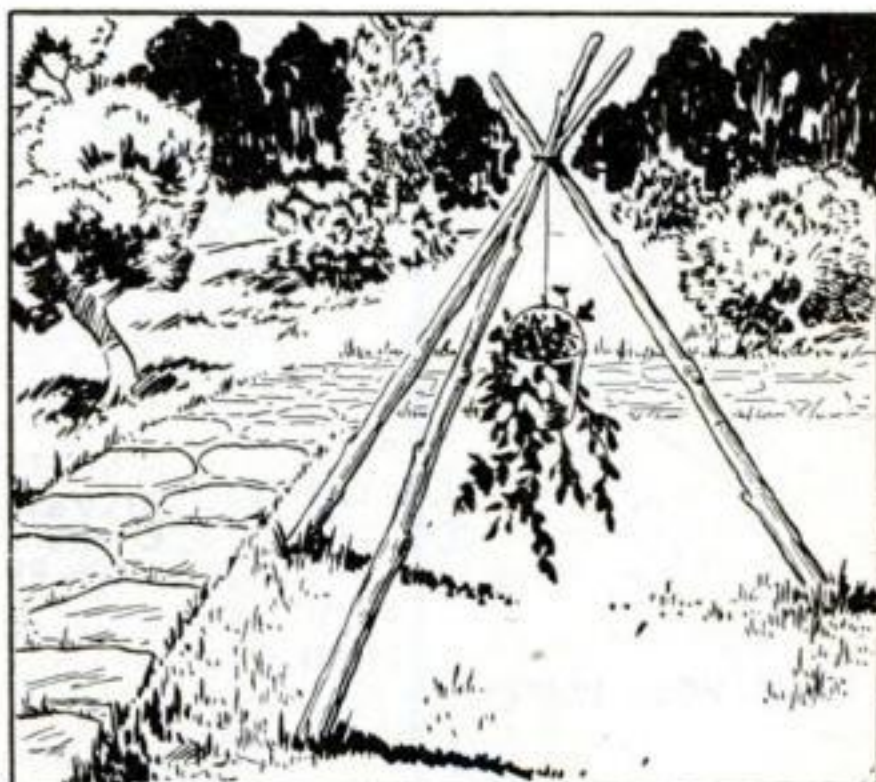
Any appropriate shade may be used with the lamp, or a plain one may be purchased and decorated with a suitable decal.—CHARLES H. HARDY.

## Tripod Makes Rustic Hanger for Pot of Trailing Vines

FOR some years I have been trimming the branches off our discarded Christmas trees and saving the trunks, mainly because I don't like to throw away wood. One day I made a tepee of three of them for our boys, but it proved a bit small for comfort. The tripod was so inviting, though, that I hung a flowerpot from it—one with trailing vines.

Where the upper ends of the trees cross, tie them together with cord or wire; force the lower ends into the ground.

Any straight, sturdy limbs will do. If you have no vines, try planting a sweet potato in the pot.—R. H. DIRCKX.





# VICTORIAN CHEST GETS A



Ex-washstand serves handsomely in a dining room.

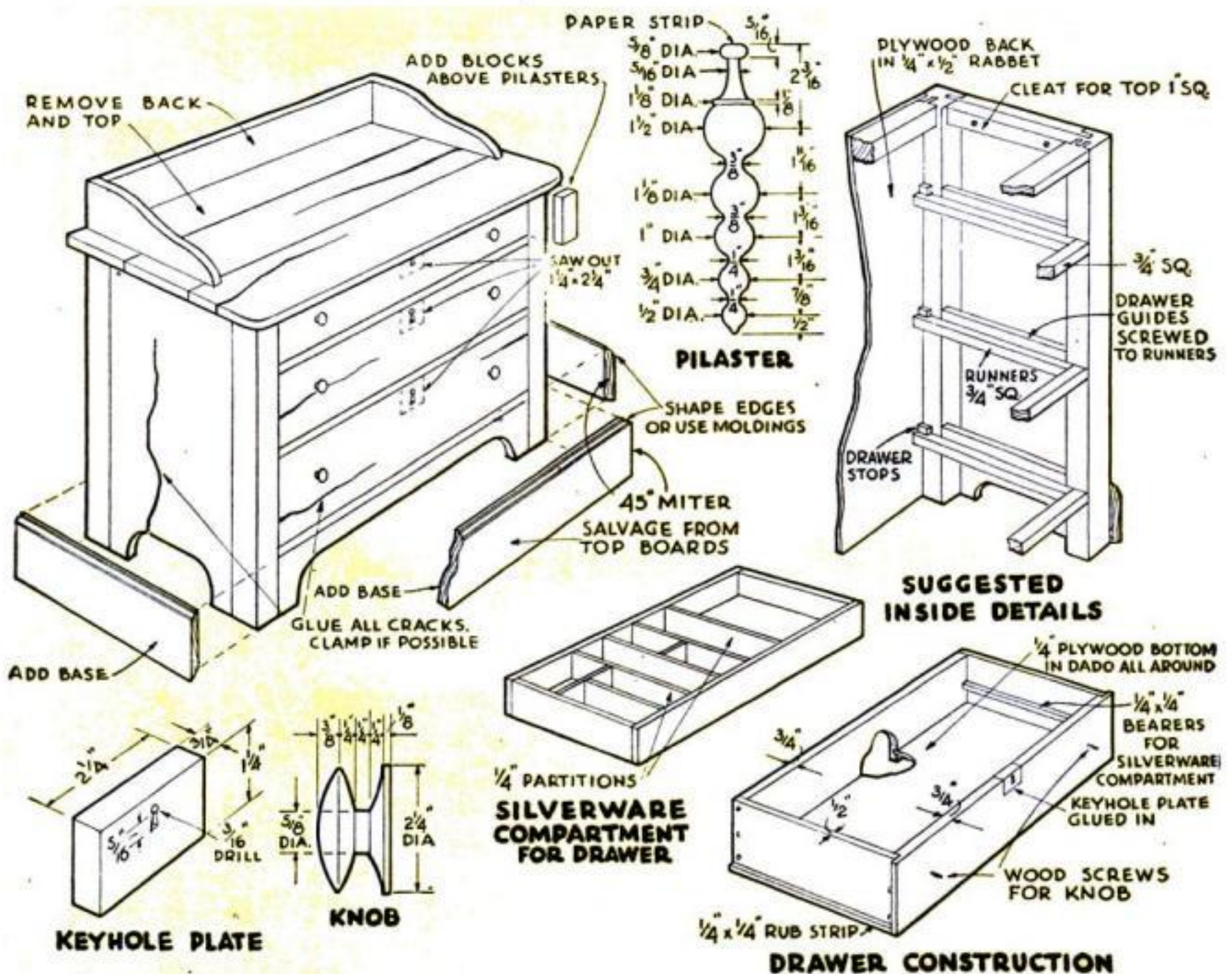
**S**ECONDHAND furniture stores used to be filled with Victorian washstands, chests, and bureaus, and they probably still are. Some of these pieces have side towel racks, some have adjustable mirrors, and

some have other doodads. Most are rickety, cracked, and covered with layer on layer of dark-brown varnish. Handles and knobs are brass, and keyholes are often marred.

Yet you can make a neat, beautiful chest out of almost any of these old castoffs. How it's done is shown in detail in the drawings below. Or, if you prefer new wood, you can use the same plans for building a similar chest from scratch.

The chest shown at left in a dining-room setting was once a dilapidated washstand. All its trimmings were first removed, and the paint was taken off down to bare wood. The top was badly scarred, so it, too, was removed, but some of its boards were salvaged, sawed to size, and used underside out for the new base hiding the commonplace legs. Sometimes a top can be turned over and reused as the top of the chest.

Next, the inside of the chest was inspected, and new runners, drawer guides, and





# NEW FACE

By NORBERT ENGELS

and stops were provided where necessary, all contact edges being rounded for smoother sliding. Drawers were squared up and tightened, and the chest itself reglued under clamps, special attention being paid to cracks and weak joints. A very rickety, sagging chest can gain added strength from center strips running from the drawer rails to the back. These also keep the drawers from dropping downward when open.

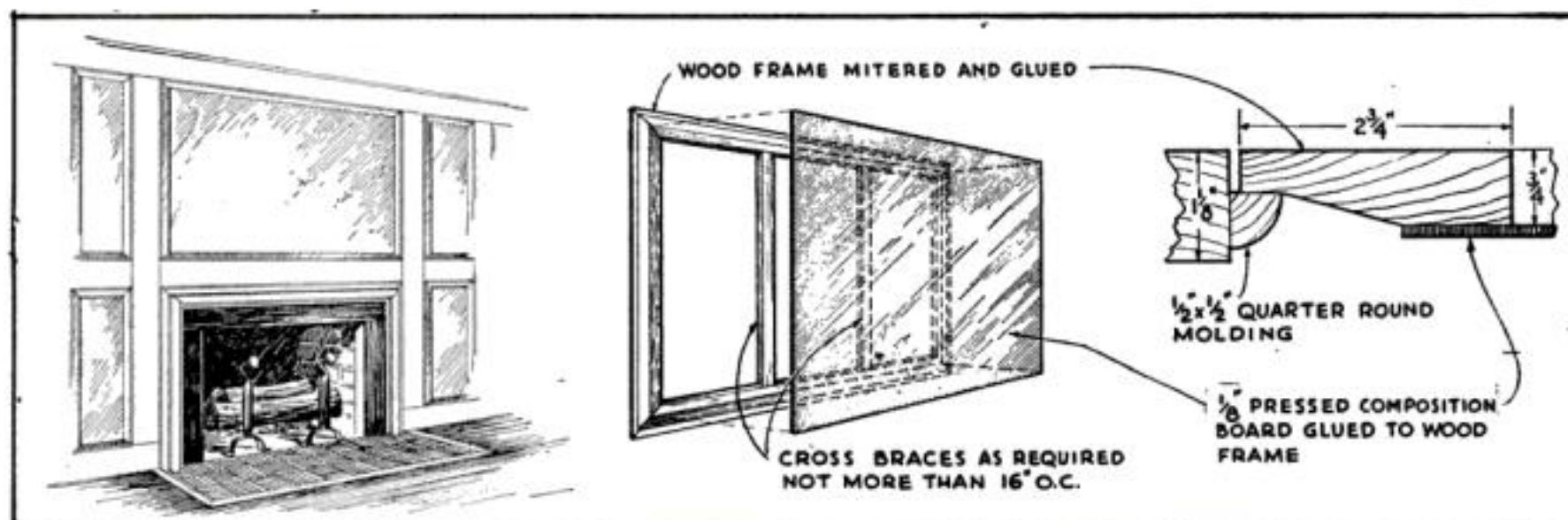
The old keyholes were sawed out, and new rectangular key plates were made of bird's-eye maple, which provided a pleasing contrast with the walnut of the chest. Some

of this same maple was turned into knobs.

Walnut blocks were sawed from scrap from the old top and glued at the tops of the front stiles above a pair of walnut pilasters. Both pilasters can be made as one turning by gluing the stock together with a piece of paper sandwiched between.

A beautiful burled-walnut circular table top was picked up for 25 cents at a second-hand shop, and a new chest top was sawed from half of it. An overhang was left at the back to compensate for the room-base-board molding, and a  $\frac{1}{4}$ " by  $\frac{1}{4}$ " plate groove was sawed  $1\frac{1}{2}$ " from the back edge.

## Raised-Panel Construction Adapted for a Large Wall Space

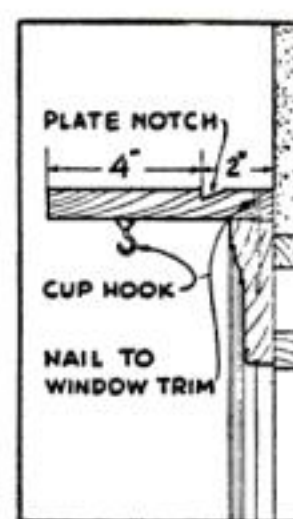


WHERE there is an oversize space, such as over a fireplace, in a wall to be paneled, framework built like that shown above will be found advantageous. With the frame carefully mitered and glued as indicated

in the drawing, shrinkage will be reduced to a minimum. The panel is glued to the wood of the frame and the frame is then held on the wall by means of quarter-round molding.—HENRY R. DIAMOND.

## Small Square Bathroom Tiles Form Initials in Cement

MONOGRAMS and other designs can be set in cement projects readily with small tiles before the cement has dried. Small square tiles are easier to fit together into a design than the octagonal type. Use them either in white or in one or more colors. The designs will be as permanent as the project itself and will not fade or lose color. — W. A. G.

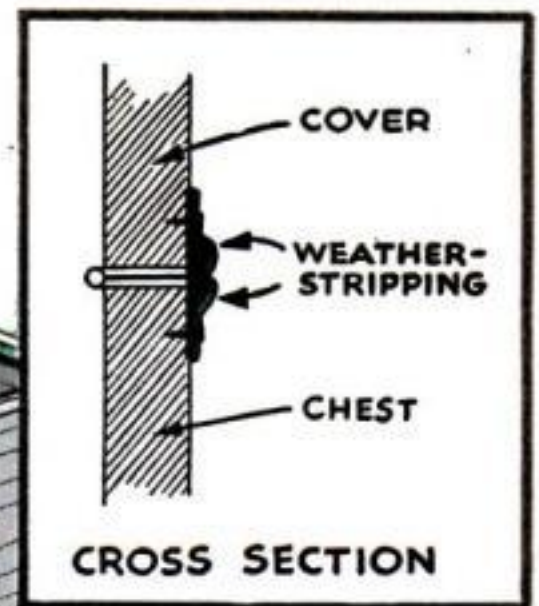
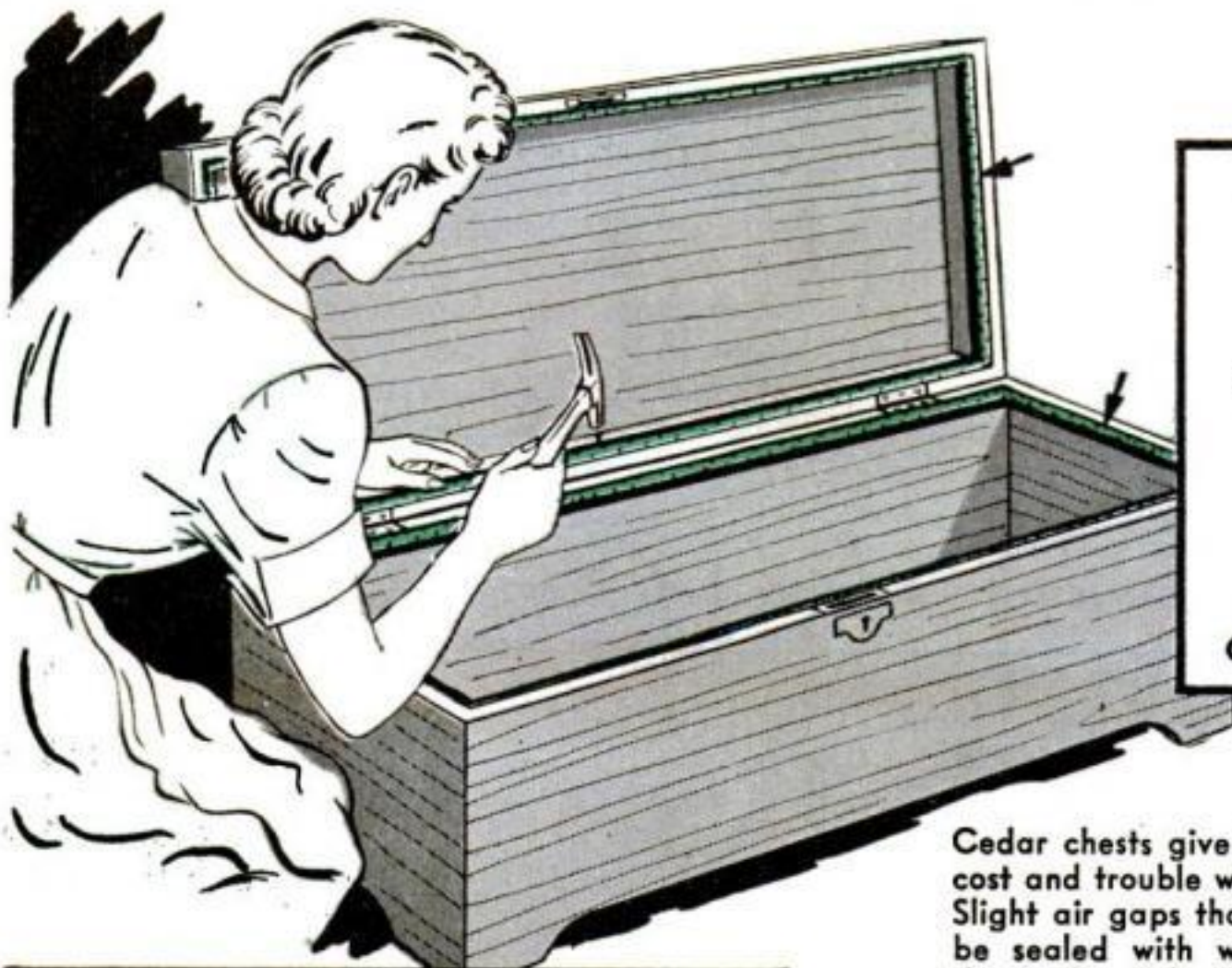


## Plate Rail on Kitchen Window

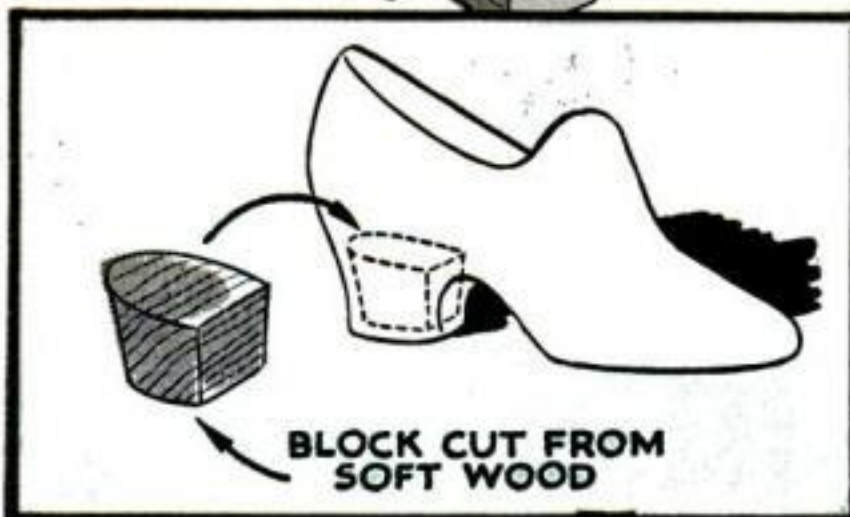
FOR an unusual decorative effect, try nailing a 6" wide cornice board to the top of kitchen or dinette windows and insert cup hooks. A valance and half curtains will admit light for showing off colorful pieces of china.—N. E.



# KEEPING THE HOME



Cedar chests give best protection with least cost and trouble when they are kept airtight. Slight air gaps that result from warping can be sealed with weatherstripping nailed to the inside of the box and cover and projecting  $\frac{1}{8}$ ". Use strips with a rubberized bead.

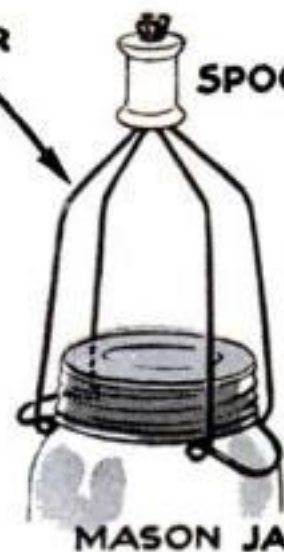


Medium-heeled rubbers can be used on flat-heeled shoes if you partly fill the overshoe heels with blocks cut from soft wood. Several layers may be glued together if necessary. Shape the wood with a coping saw and sandpaper all of the edges.

COAT-HANGER WIRE

SPOOL

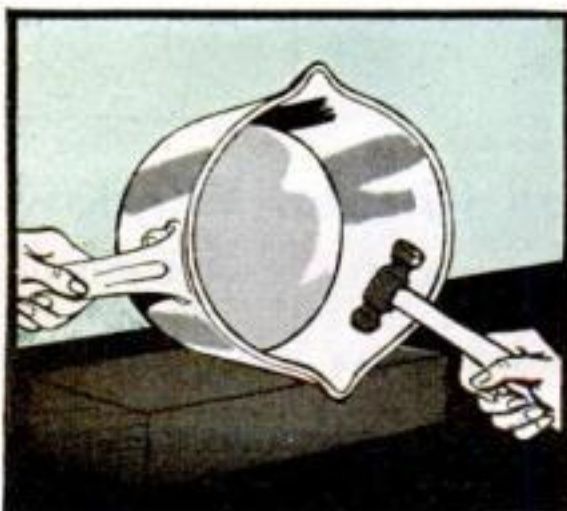
Mason jars submerged in boiling water sometimes are hard to pick up without risking scalds. This tool helps you to remove the jars safely. Bend a piece of coat-hanger wire to a spring fit so that the guide legs will catch under the lip.



If liquids pour sloppily out of your aluminum pots, use a ball-peen hammer and a block to draw a spout at either or both sides.

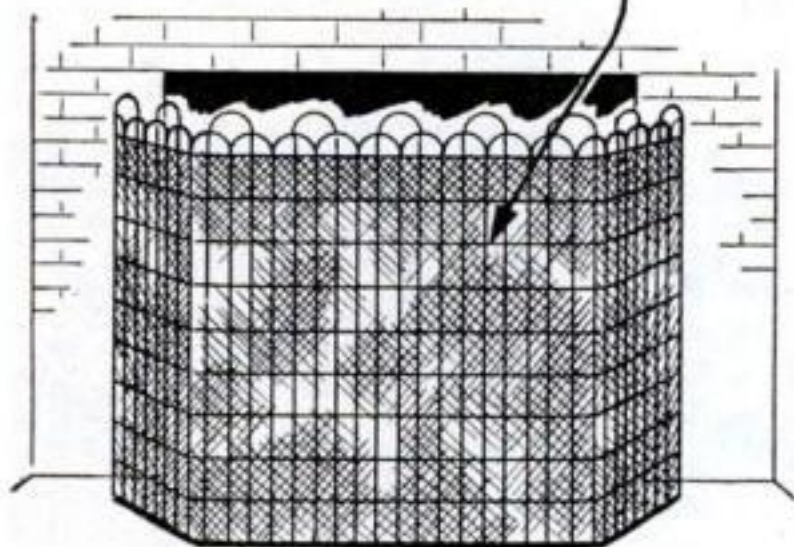
When winding yarn into balls, use the wrapper as a core. Should you have to reorder, all the required data will be available.

Flabby brooms get a new lease on life when the spreading bristles are pulled together with a band cut from an old inner tube.

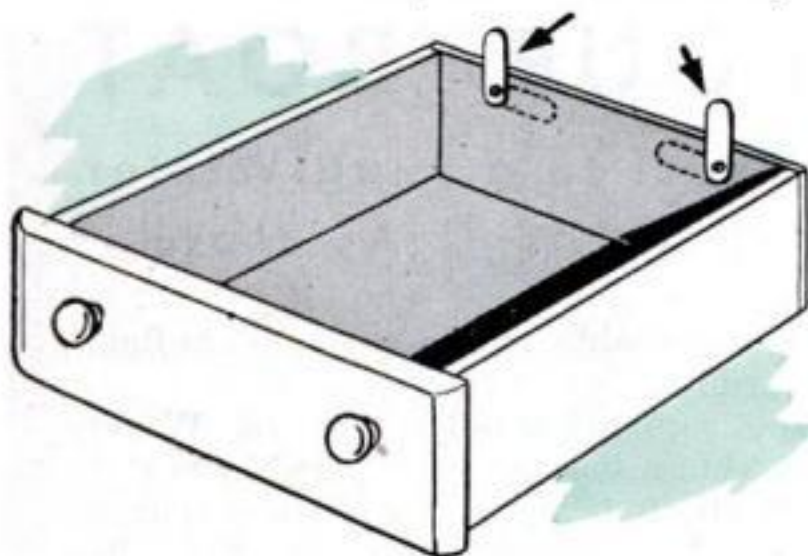




SCREENING WIRED TO  
ORNAMENTAL FENCING



Fireplace screens may still be hard to get, but a satisfactory substitute can be made by wiring common window screening to a section of ornamental wire fencing. Bend the fence as shown, and it will stand up.



If, on days when you don't know your own strength, you're liable to spill drawers out on the floor, screw wooden tabs to the back, as shown. The stoppers can be pushed down should you want to remove the drawer.

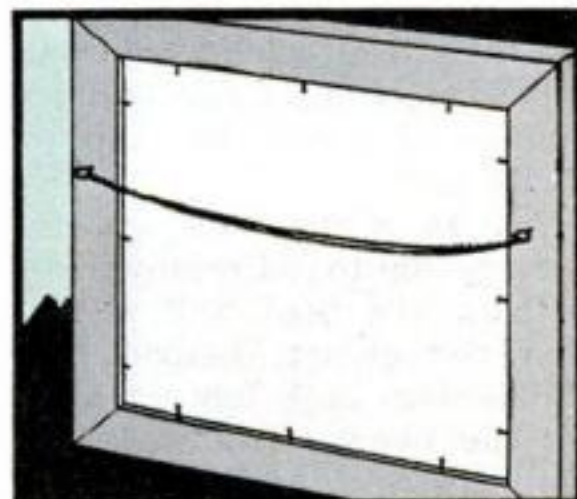
Plastic caps from empty tubes and jars may be used as drawer pulls. Fill the cap with plastic composition wood and embed a screw in it.



After cleaning rubberized canvas gloves, spread powdered chalk on them. This absorbs the fluid residue and protects the rubber.



Worn-out phonograph needles hold picture backs securely in their frames. Having no heads, they lie flat against the back.



Chimneys that project inside a room consume a fair amount of space and waste a good deal more. If your house has one of these awkward stretches of wall space, you can dress it up and put it to use with a bookcase built to fit. Nail or screw the shelves between two uprights as shown. For wider bookcases you may also need staggered supports between the shelves. Locate a beam in the wall and fasten a cross brace to it with lag bolts to keep the case from tipping.





# HAULING OUT YOUR BOAT

**Dry-Land Sailing Will Bring Small Craft to a Snug Winter Harbor Ashore—But It's a Job for Mind As Well As Muscle.**

By ELON JESSUP

**E**VEN a heavy 50' cruiser can be hauled up on land and rolled down the street to her winter berth. Smaller boats are correspondingly easier to handle, some being light enough to be lifted bodily. But as for heavy boats, you can take them almost anywhere on planks and rollers, over sea walls and around street corners.

Whatever the size of the boat and the method of hauling, it's a job for the head as well as the hands. And the first rule is, whether you roll your boat or lift her, to cut down on weight. This seems obvious enough, but it is strangely overlooked sometimes. You become accustomed to excess weight while afloat, for there, as in the case of ballast, it can even work to your advantage. But after a boat has left the water, this same weight can badly strain the craft and is unnecessarily hard on the crew of haulers.

An 18' Cape Cod knockabout normally carries 300 lb. of removable ballast. Devoid of this, the boat will weigh about 800 lb., and the owner, helped by a few willing hands, can pick her up and walk with her up the beach. But he and the same crew would strain and sweat and perhaps find

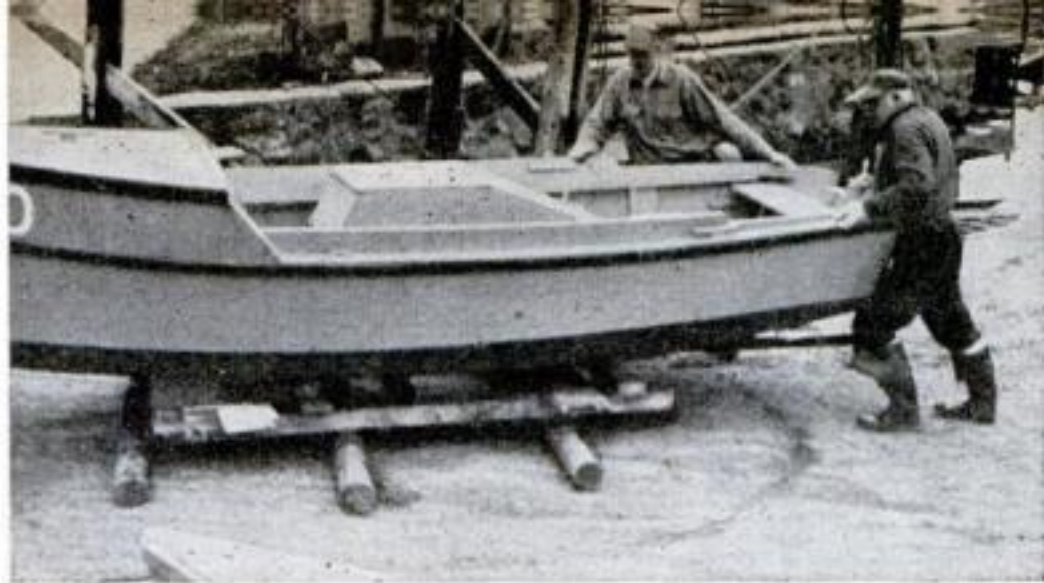
the task impossible with 300 lb. of ballast still aboard.

And this represents only one item. Water left in the bilge may be considerable, but so thinly distributed over a large area that it doesn't seem to amount to much. Actually only a dozen gallons weigh around 100 lb. Nothing more need be said about the advisability of pumping out a boat thoroughly before beginning to haul.

Carry the reduction of weight as far as practicable, even to such light articles as floor boards and bedding. Added together, they all amount to appreciable weight. The mast of a sailboat can be unstepped and the rigging disengaged. When there's an in-board installation, there are marked advantages on two counts in hoisting out the motor. Not only does it simplify your hauling problem, but it is better for both the boat and the engine to be separated during the winter. And what is more, an engine can be easily worked on if it is kept in the shop.

The ideal method of hauling out a boat too heavy for lifting by hand is admittedly the boat-yard marine railway. Probably for the majority of boats none is available, or if one is, you may wish to save the expense. In any event, you will still have to





Boats of almost any size can be handled ashore. The one at left above rests in a cradle as it is pushed on rollers. Being on hard ground, it requires no plank track such as that used for the larger craft on the facing page. At right a boat damaged by storm is being shoved on planks and rollers up over a sea wall for hauling to the owner's back yard, where it will undergo repairs before being stored for winter.

get the craft from the end of the railway to her winter destination. The logical way is with planks and rollers.

Obviously this won't be necessary for 50 or 100-lb. craft such as car-top boats and canoes. For considerably heavier boats, when there are willing hands about to help, it also may be easier to lift than to scout the waterfront for planks and rollers. One of the best ways of lifting a boat that requires the brawn of four or more men is to get two or three stout timbers athwartship

under the hull. Then put one or two men at the end of each timber.

As a rule, planks and rollers are easier on the haulers and on the boat as well. Half a dozen wide planks and three rollers may be sufficient equipment. Rollers should be 3" or so in diameter, for anything smaller won't roll so well. Wood is generally most satisfactory because the weight of piping makes it awkward to handle if you have to get a kicked-out roller forward in a hurry. Cast-iron piping is used to some extent,



One of the rollers is adjusted at left between a cradle and plank track. Only three rollers are needed for the heaviest job. Note how simple a bracing amidships over the bilge holds the boat upright. The forward ends of the cradle are cut to taper upward, as shown at right, so they will ride easily onto a roller. Pipe is used here, but 3" diameter wood rollers are best. A hauling line is fast to the cradle.

And here is the way the professionals do the job with regular marine-railway equipment. At left below, a detachable cradle is lashed to the permanent yard cradle that runs on wheels and a steel track. The rollers between the two cradles are on a plank track and serve for hauling the boat on after it reaches the end of the steel rails. At right, the two lashed cradles are sunk and the boat is floated on them.







At the end of the marine railway (left), the cradle lashings are released, planks are laid to extend the track, and the boat is hauled to level ground. Hard shoving, as at right, is needed to keep her course straight. An indirect pull by means of the block attached to a ring and chain sunk in concrete provides leverage for hauling up the incline. For an amateur job, a tree or sturdy post might anchor the block.

but it isn't very reliable. Steel is much better, especially for a heavy boat, and wrought iron is next.

Six planks are about the average number required for the track. You may be able to get by with four if you have to, but that is the minimum; or you may not need a track at all if you can roll all the way on a hard, uniformly smooth road as a foundation.

String the planks out end to end in two parallel rows just close enough together for the rollers to extend a few inches at both sides. If the ground is soft and soggy, shove a flat rock under each joint where two ends meet. This will keep an end from sinking under the moving weight of the boat. Even though your track is made of only six planks, it will actually be unending. You keep picking up the two planks left astern to lay new track ahead.

One more item of rolling gear is a cradle—unnecessary for flat-bottom boats and some others under which you can merely shove the rollers and let the boat ride on her own bottom. Where a cradle is obviously advisable or there is any doubt, an easily assembled skid of two long timbers and some shorter crosspieces will serve. Its size will depend upon the boat. The front ends should be tapered upward so they will ride easily onto the rollers.

You may have seen a boat lying on her side while being hauled in such a cradle.

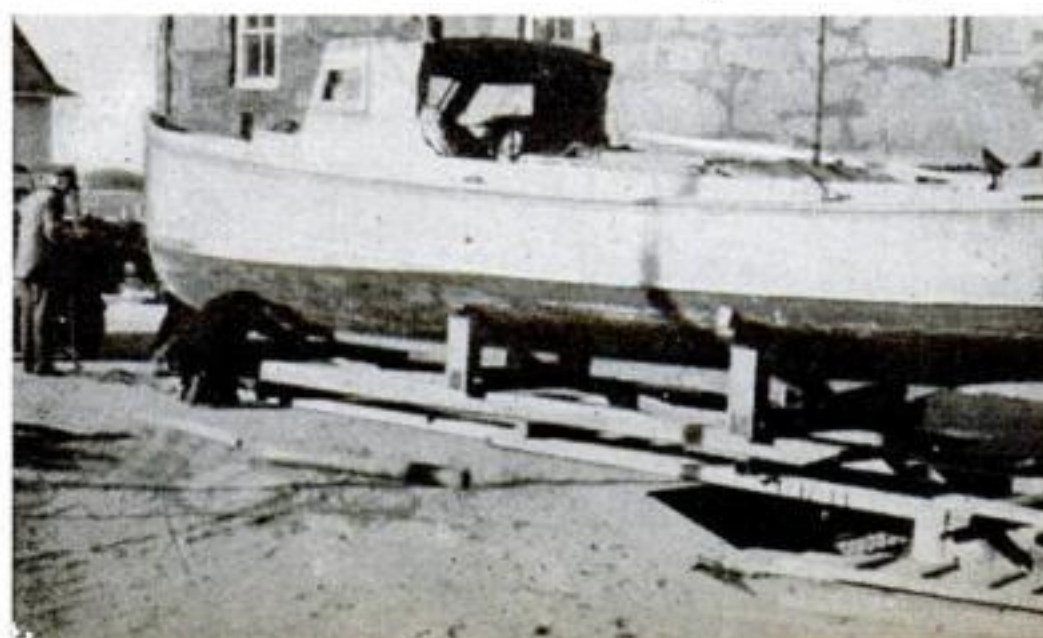
This is sometimes easier than cradling the boat upright, but it puts a strain on the boat structure and should be avoided as a rule. It doesn't take much more bracing to hold a boat firmly upright. The photo at the right below and some of those on the facing page indicate the kind of bracing, including planks against the bilge, that will serve. Take care to have the bearing surface widely distributed and don't let the braces pinch the hull planking too tightly.

If you live on tidal water, you will find it convenient to get your planks down and the cradle in place just below the high-water mark while the tide is still out. Then wait for high tide for the actual hauling operations. Under other conditions, you will have to get the gear together and actually submerge it.

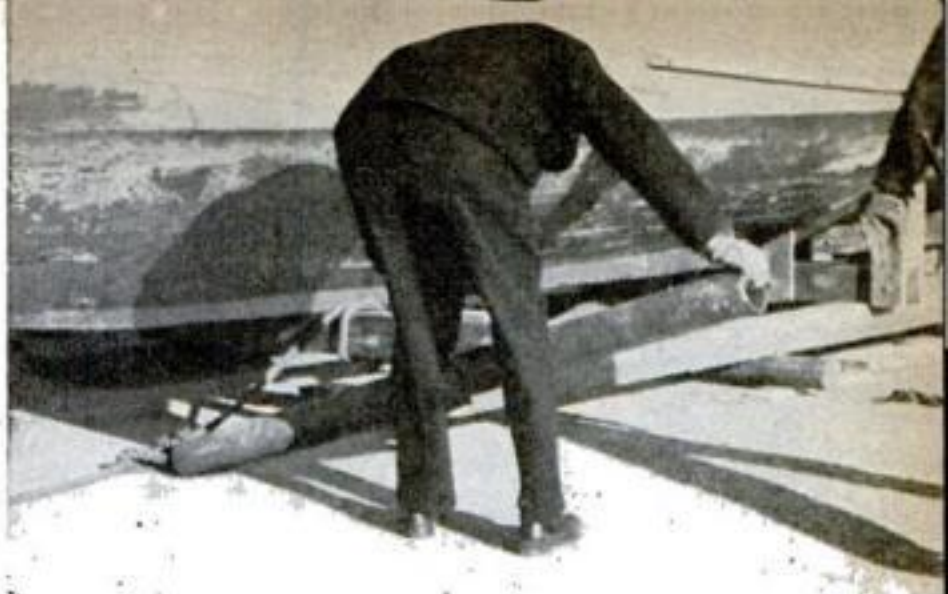
Planks and cradle will float unless anchored on the bottom. Wading with two or three helpers you can usually hold them with your feet. Rocks and other weights may be piled on, but in this case it is best to have a crosspiece nailed at the ends of the track to take the rocks so they won't interfere with the rollers. Float the boat over the cradle, and push or pull both together over the track and rollers.

You may be able to roll your boat across level ground by hand, but you'll probably need extra power to get her up the initial slope from the water. Here is where your car, or a truck if one is available, comes in.

With the hauling line attached to the front of a car or truck, as at left, the driver is able to see how the boat is tracking as she is pulled onto level ground. Backing also permits use of the powerful reverse gear. Once a boat is on the level, direct pull on the line is all that is necessary to keep her rolling, and the block is no longer needed. Note the construction of the cradle in the photo at right.







Some knack is required in handling the rollers. The boat is kept moving on the track without stopping, and the three rollers are also constantly on the go. As one is kicked out astern from under the cradle, as at left above, it is picked up quickly and rushed ahead where it is shoved under the front end of the cradle. Planks are kept on the move, too, those left behind being rushed forward for laying new track.

Most of the travel will be straight ahead, but a boat can be made to turn corners with comparative ease. All that is needed is to lay the track in the desired direction and to change the angle of the rollers, as at left below. A tap on the end of a roller with a maul will be sufficient most of the time, but for a boat as heavy as the one shown some leverage is also needed. At right, the boat on the home stretch.



Make your line fast to the front, and back the car away. Be sure to stand clear.

For the rest, it's chiefly a matter of how you handle the rollers. A certain amount of knack is required. By shifting the angles slightly you can head the boat in any direction. Turning a corner isn't at all difficult. If you wished, you could even turn the boat around in a complete circle. When a turn is to be made, lay the planks ahead in the desired direction, and then angle the rollers.

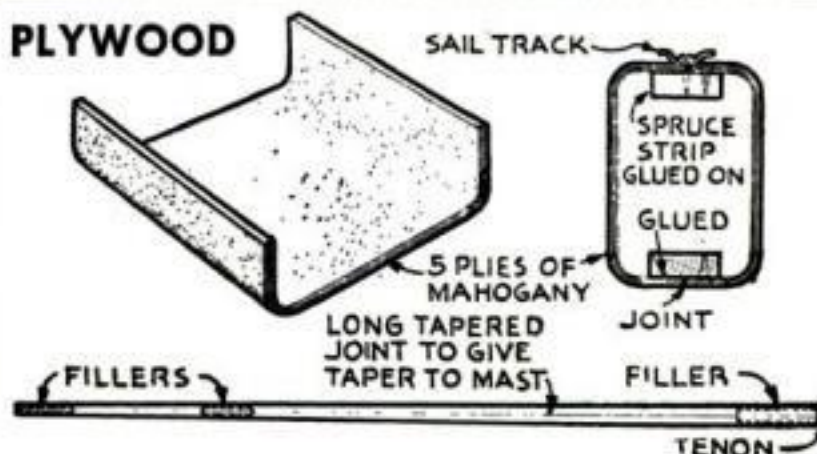
Usually rolling a boat is a simple matter

of straight-ahead travel. Properly operated, she can be kept on the move without stopping. This keeps the three rollers also always on the move. As one is left behind, it is picked up and rushed forward again.

When it comes to turning a corner, it's best to dispense with one roller and to snake around on only two. Take special pains to keep the boat and gear under control while doing this, for when one roller is temporarily kicked out astern, there'll only be one left under the boat.

## MAST MADE OF CHANNEL-MOLDED PLYWOOD

This new plywood shape, soon to be available to the public, can be built up as shown at right with strong waterproof glue. Make a long taper on the channel edges first with the circular saw. Glue in solid spruce blocks at the bottom and where the jib stay and halyard sheave will come.—WILLIAM F. CROSBY.





## Case History of a Set of Castings . . .

# MACHINING



Cast parts like these make up the air compressor at left. They come unfinished, small enough to be worked in a 9" lathe; yet the finished pump is big enough to be put to real use in the workshop.

*SETS of rough castings enable the home mechanic to build well-designed, useful projects at moderate cost. But the beginner, confronted for the first time with unfinished metal and a more or less complicated blueprint, may scarcely know how to tackle the job. On this and the following pages, C. W. Woodson shows step by step how to machine the parts of a midget air compressor. The photographs along with their captions are a case history of the job.*

**By C. W. WOODSON**

**T**HIS midget air compressor is distinguished both by its clean appearance and by its technically sound design. When hooked up to a 1/6 or 1/4-hp. motor, the pump will give a theoretical displacement of about 1,600 cu. in. at 1,000 r.p.m. for pressures up to 60 lb.—sufficient for the average small shop.

The 1 5/8" bore places the pump in the model class or the small-compressor group; but it is a very practical working model, and its sturdy construction and splash oil system permit it to be run for hours on end when occasion demands. Air is admitted to the cylinder through ports in the cylinder

walls and forced through the discharge valve in the cylinder head at high enough pressures to run a small engine, operate an airbrush or paint sprayer, clean chips from machine work, and accomplish other similar jobs.

Best results are obtained when a storage tank is used. This may be a regular hot-water tank of about 10-gal. capacity. A pressure gauge should be installed on it for information, but there is little danger of getting up too much pressure, for the motor will stall or the belt slip before tank pressures become risky. A pressure switch can be used, though it is a fairly complicated and expensive device. The pump can be run by direct connection, V-belt or, as the photo suggests, flat-belt drive.

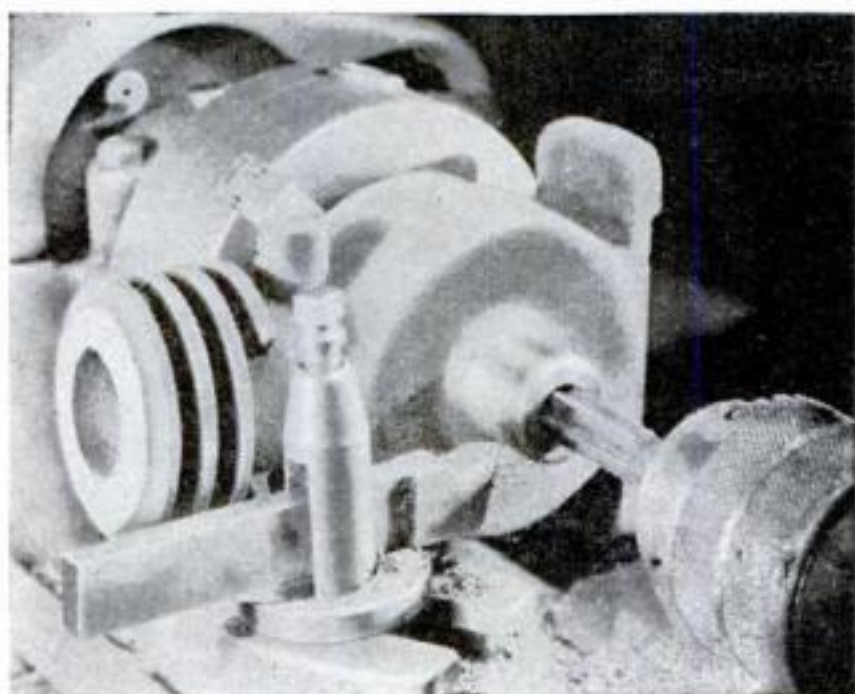
Before machining operations are begun, the blueprint supplied by the firm making the castings should be studied thoroughly. The drawing on the facing page is a section from such a blueprint. Then the individual parts of the pump or other project should be finished one at a time, accompanied by frequent checking of each part against another for accurate fit.

Always make the first roughing cut on a cast-iron piece deep enough to get under the scale. This saves considerable wear on the tool since scale dulls an edge quickly, and it assures a uniform depth for the first truing cut.

If the cylinder is bored smoothly it will not need lapping. The finish can be made almost as smooth as glass with a pointed tool having the point stoned slightly round. Use the finest power feed for the final



# A SMALL COMPRESSOR



And here is the way the job is started. Chuck the main casting with the jaws inside the crankcase opening; then drill and ream the boss to take the shaft, face the end smooth, and give it a bevel.



Reverse the piece in the chuck, holding it with the three jaws tightened up on the boss, face the crankcase opening, and bore it to the dimensions given in the blueprint supplied with the castings.

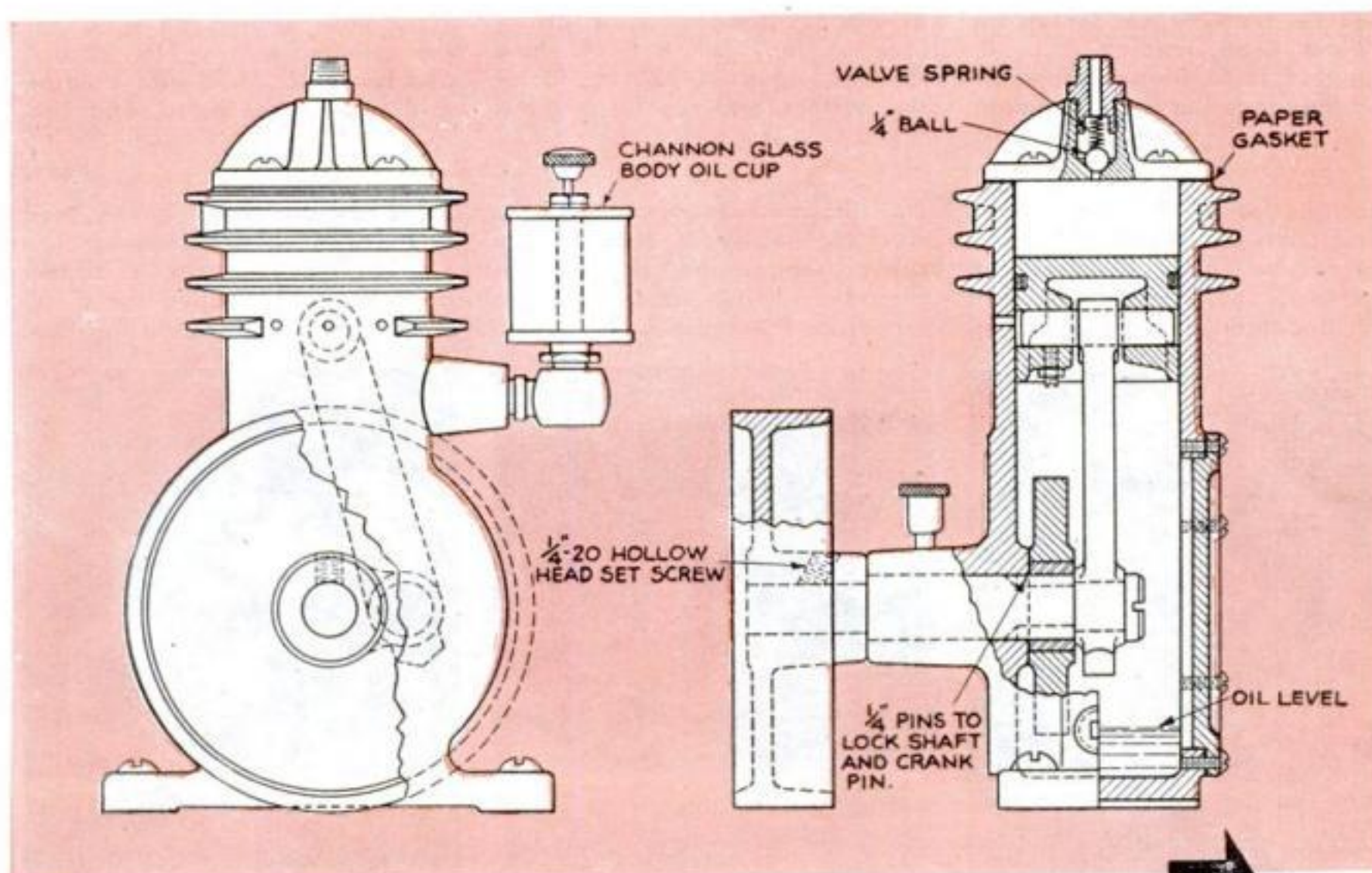
cuts. I put a 16-tooth gear on the stud and an 80-tooth gear on the feed screw to get a longitudinal power-screw feed of .0021" per revolution. Two cuts like this are generally made, the last being a very light one with a little cutting oil rubbed on the bore.

The piston will not need lapping since it is several thousandths smaller than the bore and only the ring comes in contact with the

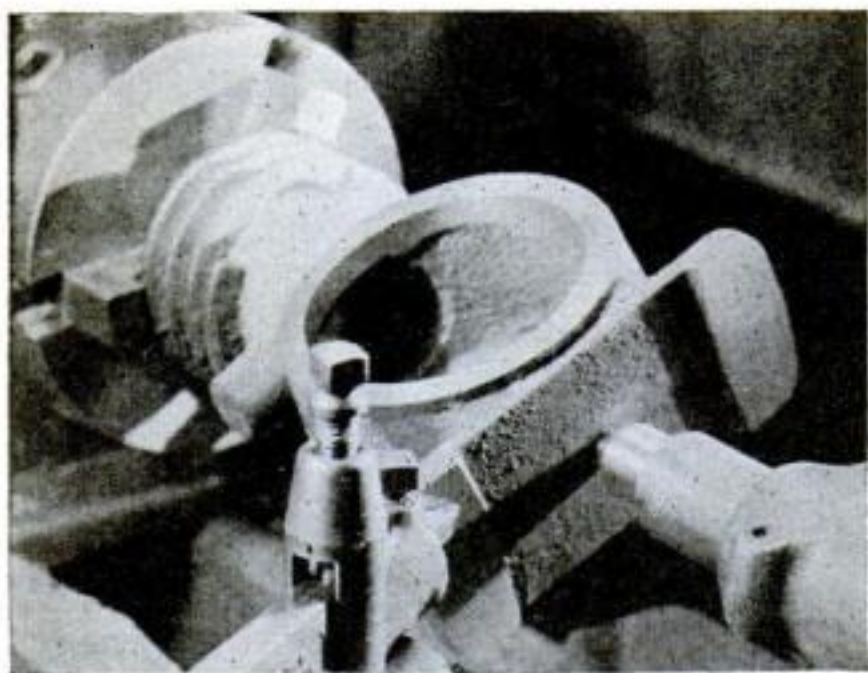
wall. Both the ring and cylinder wall wear in bright and smooth, and after that little wear will show for a long time.

Drilling for the piston pin can be accomplished accurately in the lathe with the piston supported by the crotch center. Or, if care is taken, it can be drilled from both sides in the drill press. Drill slightly undersize and ream to the correct diameter.

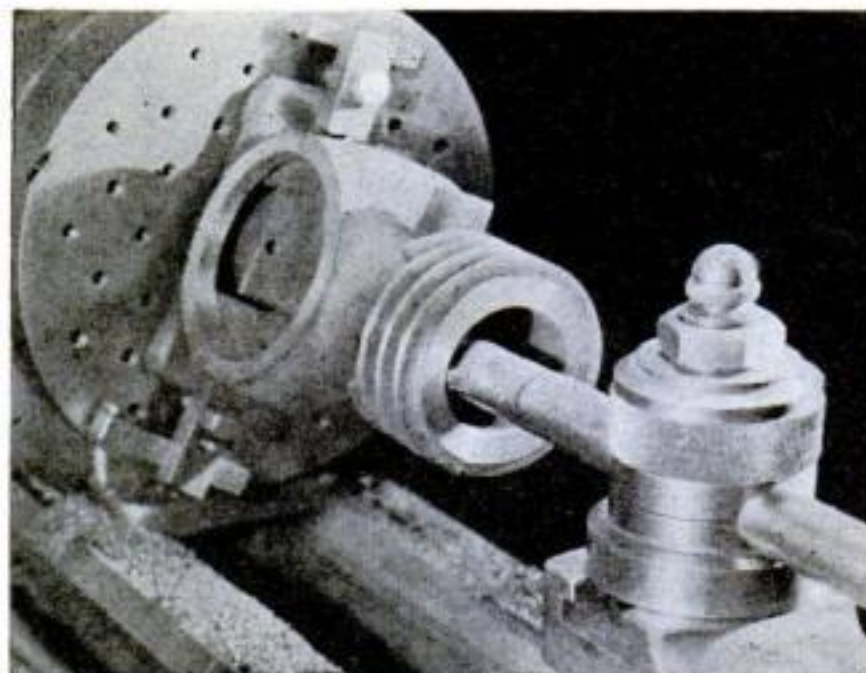
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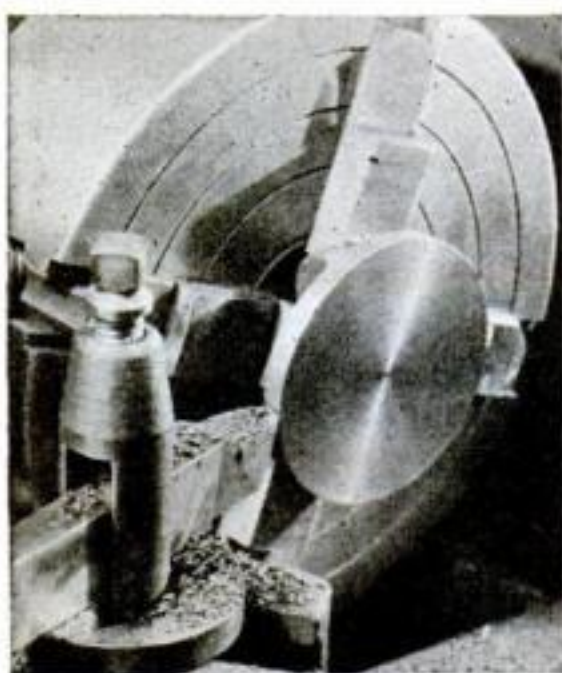




Chuck the cylinder as above, supporting the base with the tailstock, and machine the bottom of the feet smooth at right angles to the vertical, thus providing a firm footing for faceplate mounting.



Adjust the work carefully on the faceplate to run true, take a roughing cut, check again, and take finishing cuts, the last with a fine feed and the tool slightly rounded to make lapping unnecessary.



Use the four-jaw chuck for the cylinder head, holding it by its top, turn it to proper diameter, and then face the bottom smooth.



Reverse in the three-jaw chuck, face on top, drill a  $\frac{5}{64}$ " hole through, open  $\frac{11}{32}$ " to  $\frac{1}{8}$ " of the bottom, and tap for a valve.

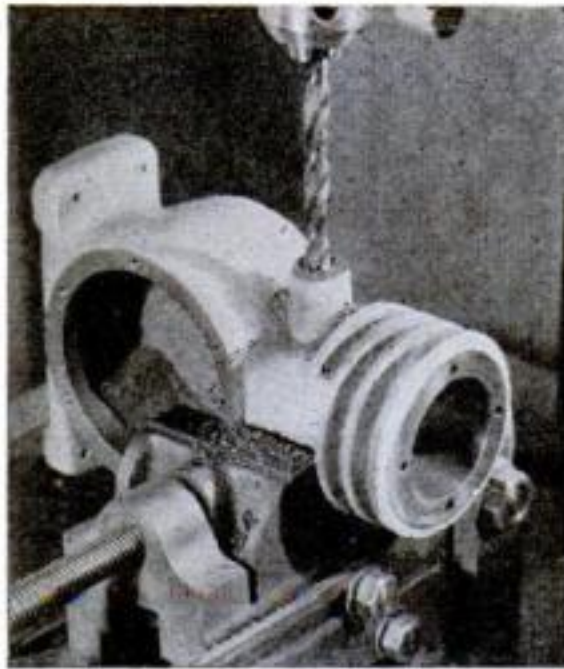
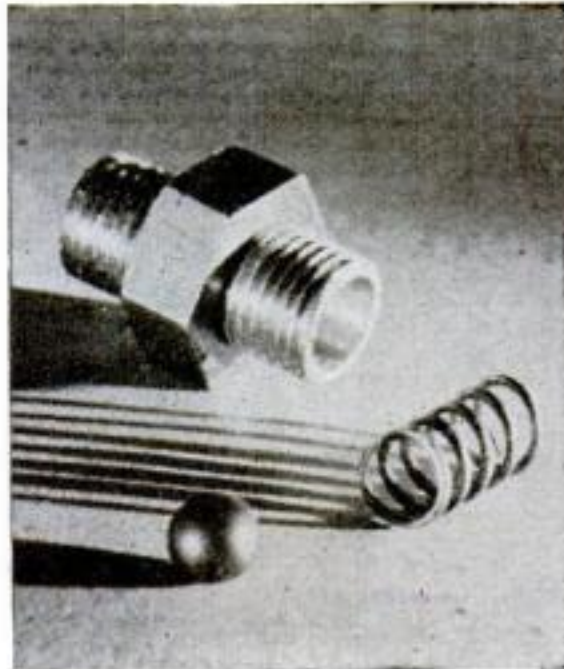


Put a hole through the head into the cylinder with a No. 29 drill and tap 8-32. Hold with a screw, drill three more holes, and tap.

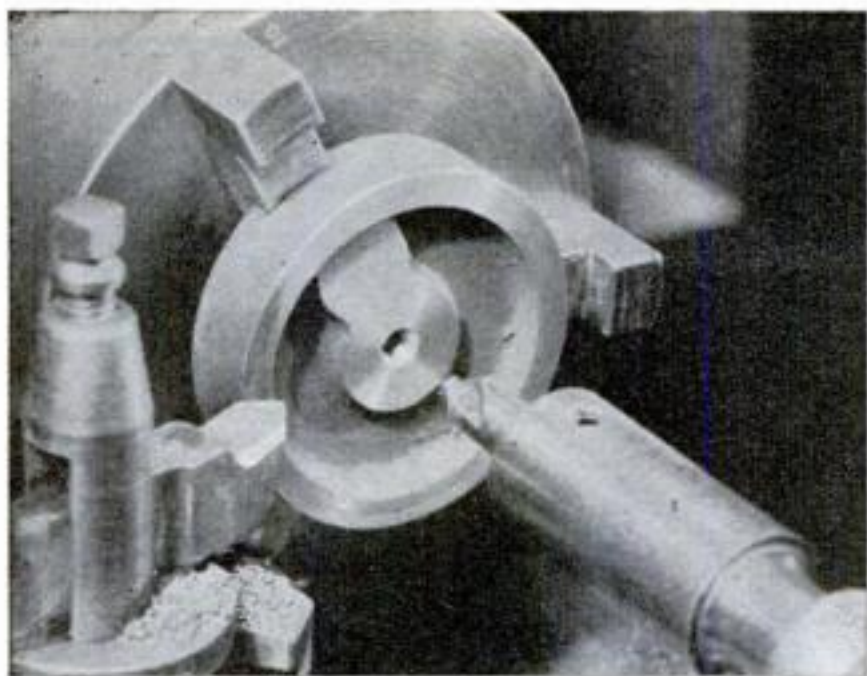
Face the inside of the crankcase cover, turn the shoulder to snap fit, reverse, face the outside, turn the edge, set in place, and drill and tap for six 6-32 screws.

Not included as a casting, the discharge valve is turned from brass hexagon rod, drilled, and threaded. Wind the spring on a mandrel. The check ball is brass.

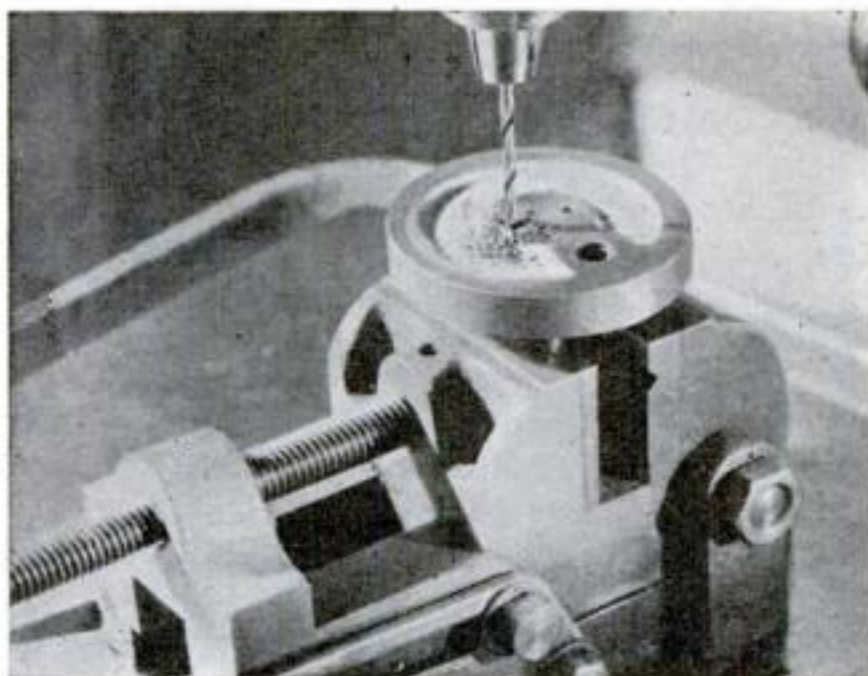
These are assembled in the head as indicated in the drawing. The hole for the oil cup is drilled, as below, and tapped for a  $\frac{1}{8}$ " angle fitting that holds the cup.



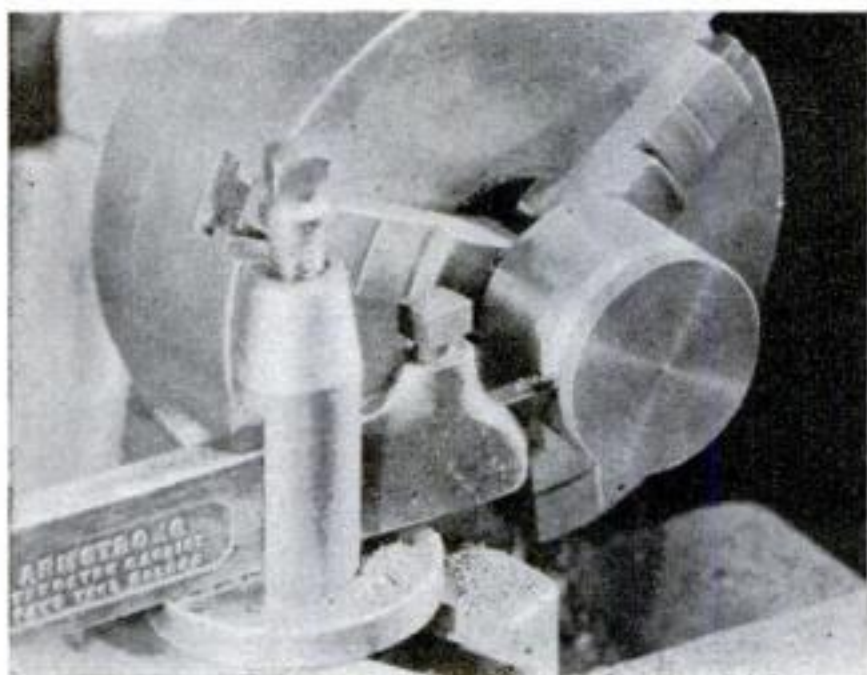




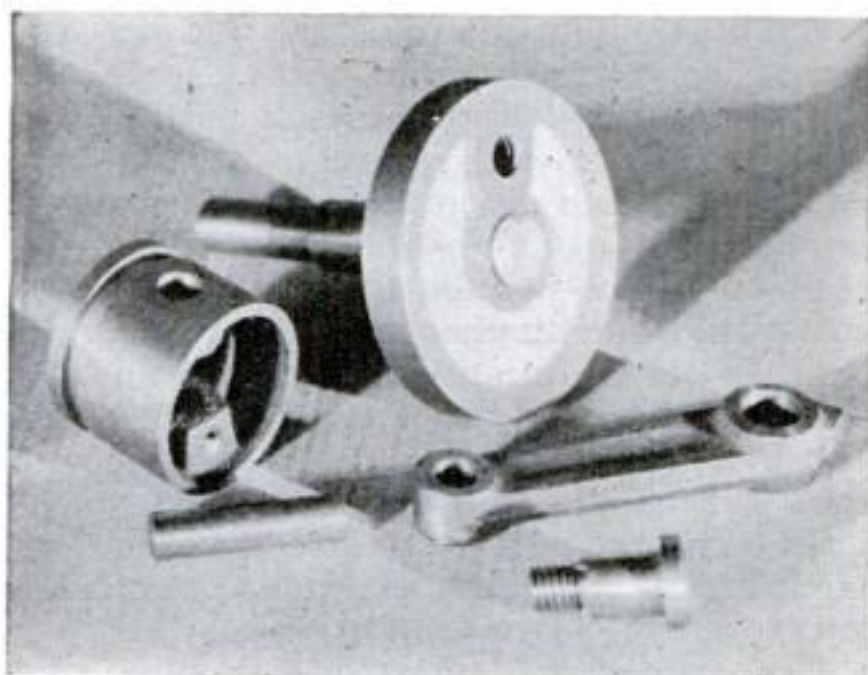
With the crank disk held in the three-jaw chuck, as above, face it smooth and drill and ream for the crankshaft. Reverse it and face the opposite side. Mount it on a mandrel to turn to diameter.



Drill and tap a crankpin hole in the drill press. Make up a crankshaft from  $\frac{5}{8}$ " bar stock turned to  $\frac{1}{2}$ " at one end, chamfer the ends, press it into the crank, and drill for two anchor pins, as above.



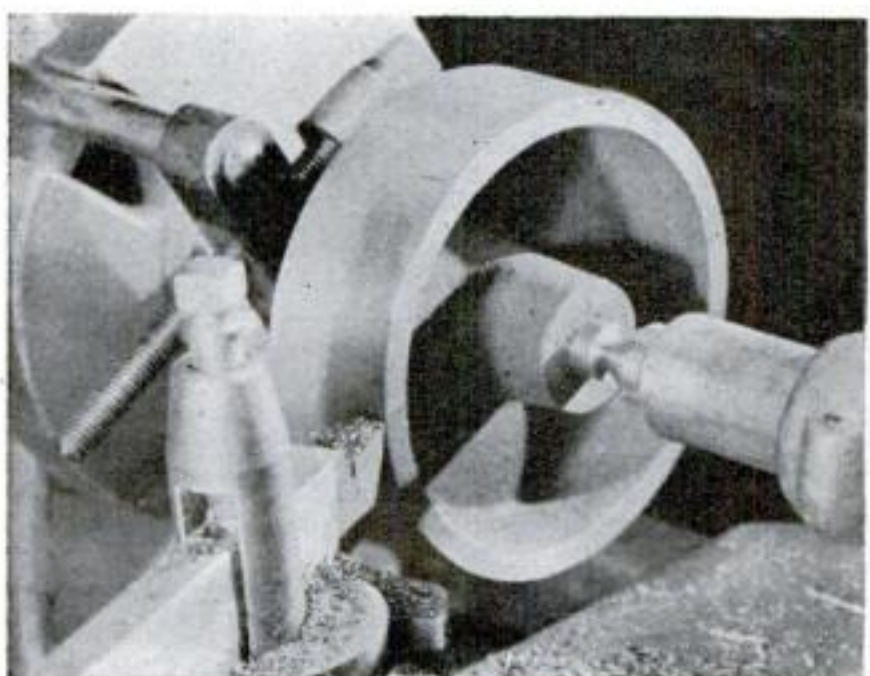
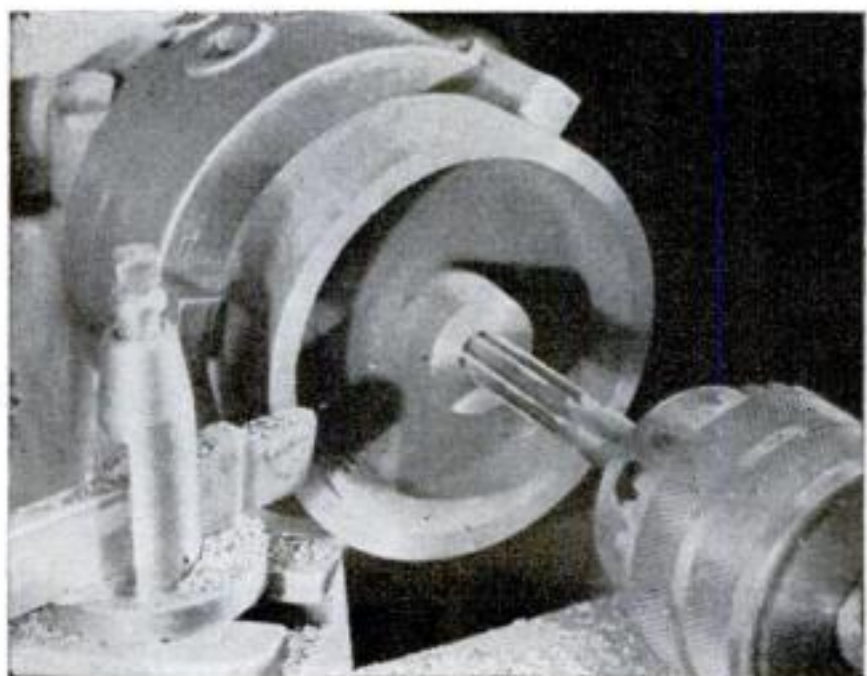
Face the piston bottom first, reverse it with the chuck jaws inside, face the top, and turn it to a snug sliding fit in the cylinder; then groove it for a piston ring. Purchase a standard-size ring.



Lay out and drill carefully for the piston pin, a piece of  $\frac{3}{8}$ " rod turned to length and chamfered. Drill and ream the connecting rod, face the boss to width, and then turn and thread the crankpin.

After a trial assembly to check for fit, you will be ready for finishing the final part, the driving pulley. Mounted in the three-jaw chuck, it can be faced on both sides and then drilled and reamed, as below, to take the small end of the crankshaft.

Mount the pulley on a mandrel and turn smooth to diameter; then drill and tap in an angle vise for a setscrew. With the various parts assembled and plenty of oil in the crankcase and cup, the pump is hooked up to a suitable motor and put to work.





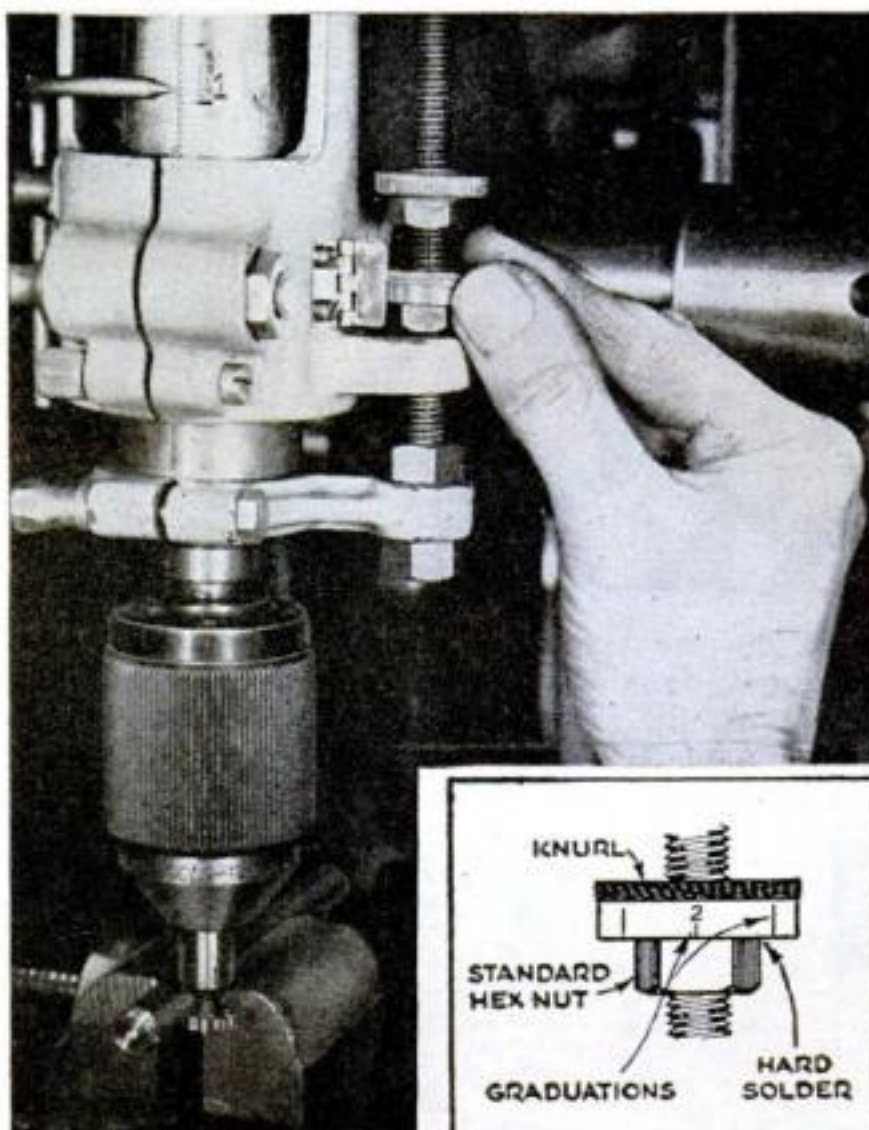
## NEW SHOP IDEAS

**MICROMETER DRILL CONTROL** is possible with a homemade micrometer nut used as a stop on the threaded drill-press rod that carries the ordinary stop nuts. The micrometer nut permits regulation of the spindle for holes of selected depth. When the drill press is used for vertical milling, it controls up-and-down movement of the cutter to small fractions of an inch.

From soft steel or brass make a disk  $\frac{3}{8}$ " thick, with as large a diameter as clearance permits. Drill and thread it to fit the drill-press rod, and then, with the rod or a similar bolt as a mandrel, true it in the lathe, turn two thirds of the face to slightly smaller diameter, and lightly knurl the remainder. Hard-solder a hexagon nut to the face away from the knurling, using the mandrel for aligning the threads.

Calibrate the micrometer nut on the smooth part of the round piece. This may be done on the drill press itself with a milling-machine indexing attachment and a fly cutter, or it can be done in a lathe that has an indexing attachment, the marks being cut with a fine-pointed tool mounted in the tool post. The number of calibration marks depends on the pitch of the thread and the accuracy desired. Since the nut shown had 16 threads to the inch and moves  $\frac{1}{16}$ " with each full turn, eight equally spaced marks on the circumference indicate  $\frac{1}{128}$ " movement each. Alternate marks are numbered 1 to 4 to make 64ths easy to read.

Use one of the knurled lock nuts that come with the drill press for locking the micrometer nut. Hard-solder a hexagon nut

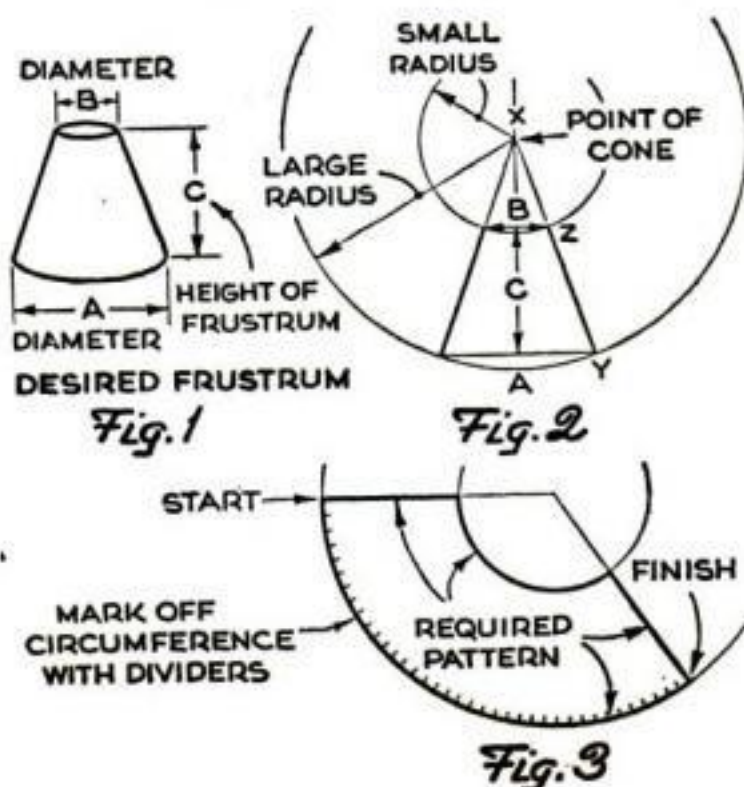


to it for use with a wrench. A small brass hinge bolted to the drill-press body provides an index line and can be swung out of the way when not in use.

For either drilling or vertical milling, lower the spindle until the tool touches. Run the micrometer nut down as far as it will go, and then back it up the desired number of turns and lock it.—W.E.B.

## CONICAL PATTERNS

### [SHOP METHODS]



It is frequently necessary to lay out a pattern for a cone or frustum to be constructed of sheet metal, paper, or other flat material.

Determine the desired two diameters and height of the frustum as in Fig. 1. On the work or on a large sheet of pattern paper lay out line A of the same length as diameter A, as shown in Fig. 2. With a compass or a square construct a perpendicular centered on line A and mark off the required height (C) of the frustum. Mark off line B parallel to line A and of the same ends of lines A and B, extending both sides to x.

With a compass set from x to y, draw the large arc as shown in Fig. 2. With the compass set from x to z, draw the small arc. In the case of a cone pattern, instead of a frustum, the small arc would be omitted and point x would become the center of the pattern.

To find the length of the pattern, multiply diameter A by pi (3.1416). Set a pair of dividers to as small a fraction of the circumference thus determined as is practicable; for example, if the circumference required is found to be 16", set the dividers at 1". Starting from a base line running from the large radius to the point, mark off with the dividers the number of spaces necessary to give the required circumference. From this finishing point draw another base line to the center point. The area bounded by the start and finishing lines and the two radii is the required pattern.

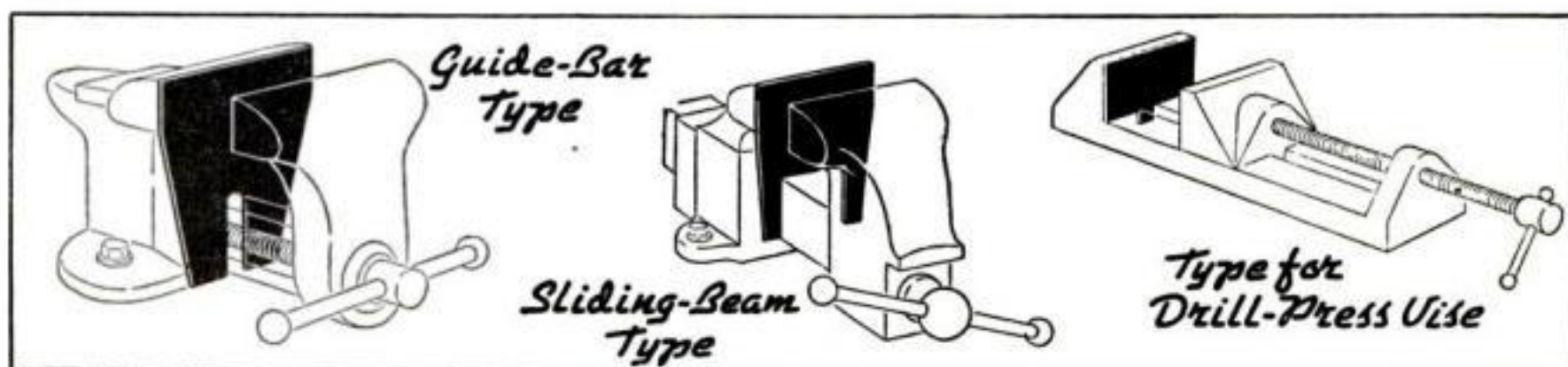
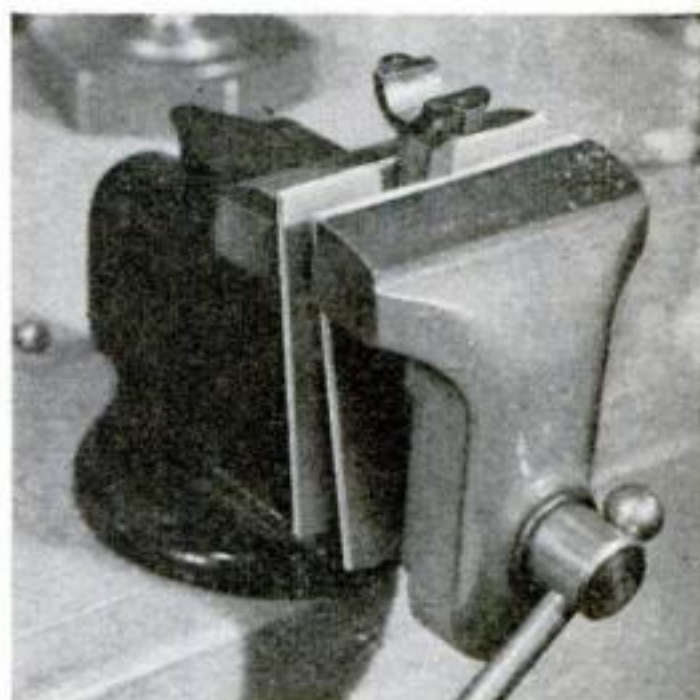
Since the dividers actually measure a small chord rather than an arc, a slight error is involved. For most practical purposes this is negligible.

POPULAR SCIENCE MONTHLY SHOP DATA



**SOFT VISE-JAW GUARDS** for holding threaded, odd-shaped, or highly polished parts can be made for bench or drill-press vises as shown at right and in the drawings below. Held in position by the guide rod, sliding beam, or vise bed, they are simply dropped into place, require no adjustment of straps or other attaching devices, and can't fall off.

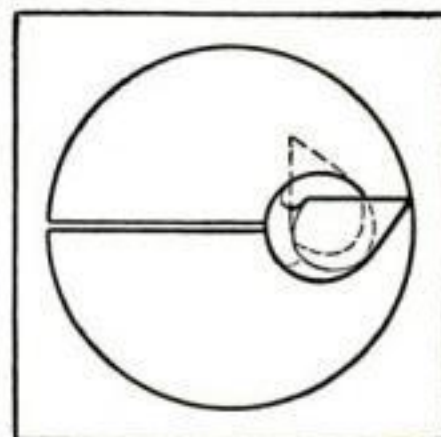
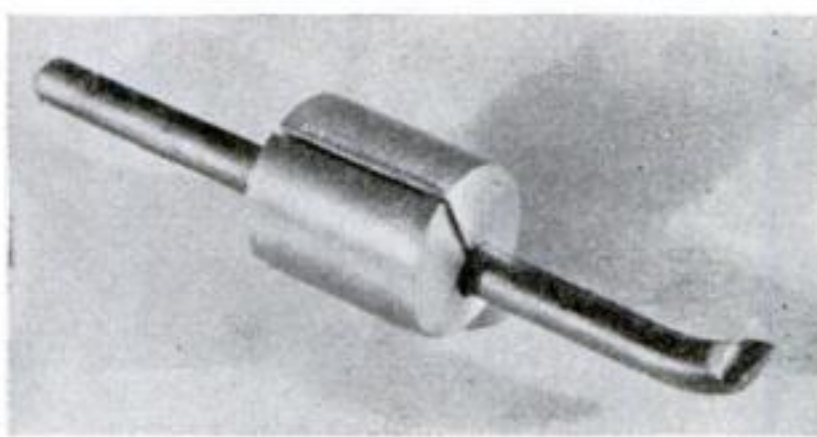
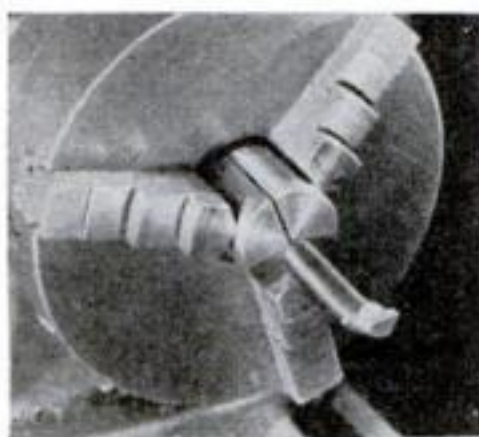
Make the top edges of the guards come as near the working edges of the vise jaws as possible. Experimenting may be necessary for a good fit. It is wise to make a permanent metal pattern for each vise in the shop and to cut from it several pairs of guards of plywood, composition board, sheet lead, and copper. With these always handy, there will be less temptation to use makeshifts or no guards at all on work that might be damaged.—WILL THOMAS.



**QUICK BORING ADJUSTMENTS** for opening out the diameter of a hole in work mounted on the cross slide of the lathe can be made with a boring bar like that shown below. The cutting edge is advanced for each cut by turning the bar in the split holder slightly away from the center of the

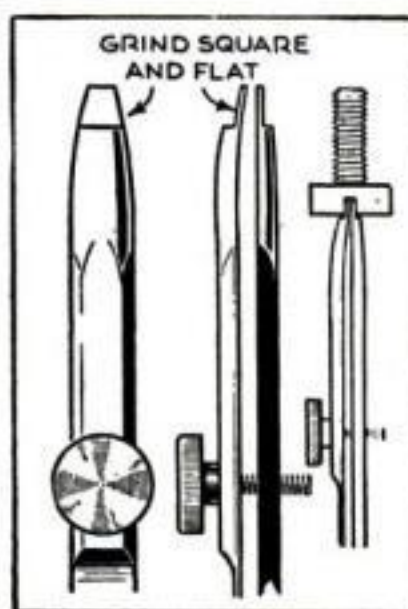
hole. Small changes in the cutting-edge angle do not affect the quality of work.

The holder is a short length of 1" diameter cold-rolled steel drilled off center with a hole the exact diameter of the boring bar. It is slotted with a hacksaw to permit clamping.—C.W.W.



**SMALL SCREWS CAN BE HELD** and put in place with a split screwdriver made by grinding flat the points of a discarded drawing pen. The flattened ends are inserted in the screwhead slot and the nut loosened to expand the prongs.—SIDNEY POTT.

**CHUCKS WON'T DROP** on the lathe bed when being put on or taken off if the push rod is inserted first through the spindle and left projecting about 6". A chuck falling off the spindle will still be held safely by means of the rod.—E. E. JAMISON.





# PICTURES BY PACKAGED LIGHT

Want to take a photo of a black cat crouched in a coalbin at midnight? Flash photography will do it—and many other things. Here are some facts from a camera authority to help you get better pictures in a flash.

By KENNETH S. JOHNSON

**T**HERE is an old schoolboy gag about drawing a picture of a black cat at midnight. The drawing consists simply of a sheet of paper rubbed with a pencil until nothing but blackness shows. Actually, with a camera equipped for synchronized flash, you can take a photo of a black cat at midnight, and get a good picture to boot. You can make it a good stop-action shot of the pitch-hued feline as she darts across the coalbin.

The sunlight brilliance of the flash lamp is perhaps best known in high-speed exposures of indoor sporting events. It is equally important for taking lifelike portraits and for better pictures of a wide variety of camera subjects. Flash also provides a completely self-contained and easily carried source of illumination that makes the photographer independent of power lines, bulky floodlights, and cumbersome light stands.

Two general types of flash synchronizers, mechanical and electromagnetic, have found

wide acceptance among amateur and professional photographers. The mechanical type uses electric current from batteries solely for the purpose of firing the lamp, the shutter being actuated manually by a release plunger, which is an integral part of the synchronizing switch. In the electromagnetic flash gun, battery current not only fires the lamp but operates a magnetic or solenoid device that trips the shutter.

Correct synchronization of mechanical flash guns is usually achieved by adjusting the distance the plunger must travel before making contact with the lever actuating the shutter. Instructions for the Kalart flash gun, for instance, recommend adjustment of the plunger until it is just long enough to trip the shutter at its highest speed. This synchronizes for all shutter speeds. The method of synchronizing electromagnetic guns depends on the make. In general a thumbscrew or setscrew is turned to vary the air gap in the magnetic circuit of the solenoid.

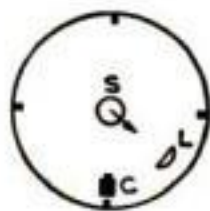
Trouble-free service can be expected from a good synchronizer, but like any other pre-



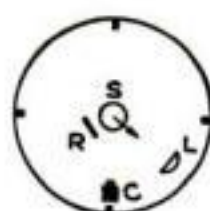
Photos courtesy Wabash Photolamp Corp.



**FAIR.** Flat lighting and dense edge shadows mark the picture when the flash lamp is in this position, - often used in news photos.



**BETTER.** Improved by use of a short extension cord, the flash now gives greater modeling to features and eliminates edge shadow.



**BEST.** The same position of the lamp as in center photo. But face shadows are made less strong by means of a cardboard reflector.





Typical multiflash equipment. A 15' cord connects the secondary reflector to the synchronizer battery.

cision instrument, it should be checked occasionally for accuracy. One reliable test requiring no special equipment is to watch through the front of the camera lens for the flash of a lamp placed behind the open camera back. If a bright flash can be seen through the lens when the synchronizer button is pressed, then synchronization may be considered satisfactory. If not, adjustment is necessary.

Excellent flash pictures are possible without a synchronizer by the method known as "open flash." The camera is set on a tripod or other support to prevent jarring, the shutter opened on "bulb," the lamp flashed, and the shutter closed again. As a rule, home lights may be left burning since they are not bright enough to affect the negative during the short time the lens is open. Stop-action pictures can be made with a quick-burning lamp such as the General Electric SM or the Wabash SF. These lamps flash for only about 1/200 second, and results are similar

to 1/200-second shots with synchronized flash.

Aside from its speed and convenience, flash is not essentially different from photoflood illumination. If the flash lamp is used at the camera, the lighting will be approximately the same as that of a photoflood lamp in the same position. Shadows are thrown away from the camera and slightly to one side. This is a flat type of lighting, not ideal under all circumstances, but widely and profitably used in sports work, for taking young children at play indoors, and for other kinds of high-speed photography where a well-exposed stop-action picture is more important than beautiful lighting effects. It is the simplest of all lighting arrangements and practically guarantees a picture every time.

With a 3' extension cord connecting the lamp to the synchronizing unit on the camera, the light may be directed from above or from one side of the camera to produce



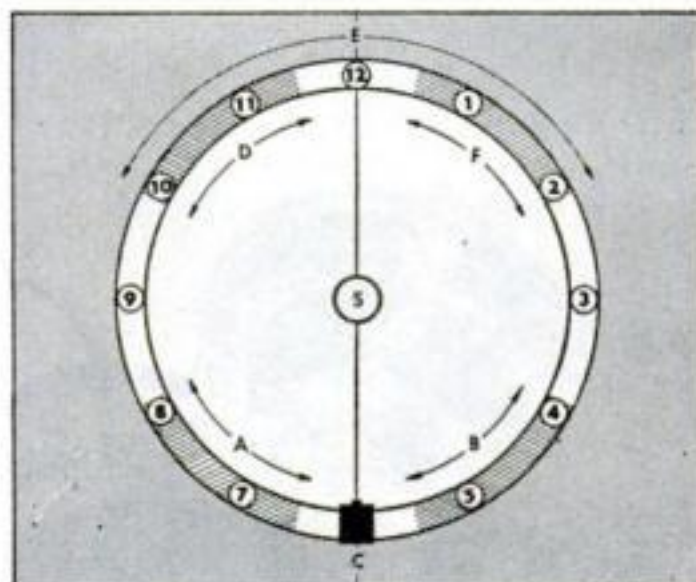


Photo courtesy General Electric.



Even in strong sunlight, a flash lamp is useful. For the photo at left, a flash beside the camera filled in dark, side-lighted shadows to reduce harsh contrast.

**FLASH BY THE CLOCK** is a sure guide to good lighting. Consider your camera always at 6 o'clock, the subject in the center, and one or more lamps on the dial. In general the main lamp is best in areas A or B or at the camera. A fill-in lamp for a main lamp in A may be somewhere in B, or in A for a lamp in B. Use back light from D or F on a diagonal from the main lamp, anywhere in E for a lamp at C. A main lamp near 3 or 9 o'clock is for special effects.



an interesting interplay of high lights and shadows. As with photoflood lamps, a subsidiary reflecting unit or lamp may also be employed to fill in and lighten dark shadows that too frequently produce harsh, unattractive contrasts.

If your portrait subjects "freeze up" and look grim when asked to hold a pose for half a second or so, or if they squint or frown under the heat and glare of photofloods, try photographing them at 1/200 second or faster with synchronized flash. They will appreciate your thoughtfulness and compliment you on your photographic skill—particularly when they see the natural, lifelike quality of the finished print.

A basic lighting arrangement for high-speed portraiture consists of one lamp on a 3' extension cord and a subsidiary reflector. Numerous refinements are possible when two lamps are used. The second lamp, which may be connected with the synchronizer by a 15' cord, can be used for lighting background areas that might otherwise be underexposed, for filling in shadows or washing them out, for back-lighting, or for any of a variety of other purposes. The extension lamp reflector should be equipped with a rubber-covered spring clamp so it can be attached to any convenient support.

The position of the second lamp depends, of course, on the subject and the desired effect. For lighting the background, it may be at one side or possibly behind the subject; used as a back light, it frequently illuminates the subject from the side and rear.

The face of a clock serves as a handy, easily remembered lighting map. If you consider the camera permanently fixed at 6 o'clock and the subject situated in the center of the dial, any position between 4 and 8 o'clock is suitable for a front, main-light flash lamp and any between 10 and 2 for a back light. Usually it is best to have front and back lights on opposite sides of the 6-12 axis. Positions near 3 and 9 o'clock produce heavy shadows and are generally more suitable for special effects than for the ordinary portrait.

Guide numbers supplied by the lamp manufacturers provide an accurate, dependable means of obtaining correct exposure. Each is based on the use of a definite lamp, film, and shutter-speed combination. The missing factor, the lens aperture, is calculated by dividing the guide number by the distance between the lamp and subject. For example, the guide number for the Wabash No. 40 flash lamp used with



Two flash lamps were used for the child portrait at right, one as a main light at about 7 o'clock and the other beside the camera as a fill-in for the shadows.



**SYNCHRONIZED FLASH** is based on the perfect co-ordination of shutter movement and flash-lamp operation. As shown by the curve below, a lamp begins to burn 5/1000 second after current is applied, reaches peak brilliance at the moment a properly synchronized shutter opens to full position, and burns out 25 milliseconds later. When a shutter opens either before or after the peak, underexposure or no exposure may result.

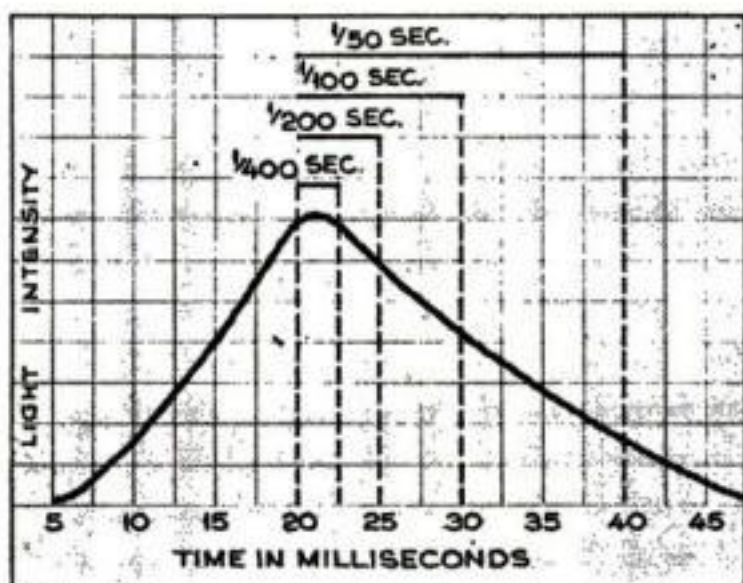


Photo courtesy Wabash Photolamp Corp.

Supreme film at 1/200 second is 110. Then, with the lamp at 10' from the subject, the diaphragm opening would be f/11 ( $110 \div 10 = 11$ ). When a specific diaphragm opening is necessary for sufficient depth of field, the guide number may be divided by the aperture to obtain lamp-to-subject distance. Thus, for an f/16 aperture, the same lamp must be about 7' from the subject ( $110 \div 16$ ).

In all cases the exposure depends on the distance of the lamp, not the camera, from the subject, for the calculation is for the amount of light that reaches the subject. The guide numbers are based rather closely on the fundamental physical law governing light intensity, which varies inversely with the square of the distance. With a lamp 5' from the subject, the indicated lens aperture with this bulb and film is f/22 ( $110 \div 5 = 22$ ); when the distance is doubled to 10', the required lens aperture ( $110 \div 10 = 11$ ) is f/11, a four-time increase in exposure.

Reference to this inverse-square law greatly simplifies the task of achieving lighting balance when two or more flash lamps are used. Obviously if two lamps of the same light output are placed the same distance from a subject, the illumination will be uniform and modeling and gradation will be destroyed. But the secondary

lamp at twice the distance of the main light will illuminate the subject by only 25 per cent, just enough to lighten the shadows without destroying the desired modeling effect of the main light.

Unless both lamps are at the same distance and all the light is superimposed on the subject, the nearest lamp should be considered the main source, and the exposure should be computed on the basis of the distance from the main light to the subject. The subsidiary light or lights may be ignored.

This is also true when a flash lamp is used out of doors, but in this instance the sun is always the main light, and its illumination alone, determined by meter or any other method you have found reliable, need be considered. The flash lamp is simply to brighten shadows and reduce contrast, and it exerts little or no influence on exposure.

In outdoor photography a flash lamp is most often needed when side or back-lighting by brilliant sunshine would otherwise produce dark shadows and harsh contrasts. It is less necessary when the sun is overcast. Synchro-sunlight photography is most successful when the flash lamp fulfills its purpose without betraying its presence, and the picture appears to have been made by

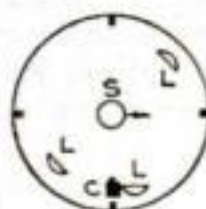




Photo courtesy General Electric.



Good lighting effects, for photos like those at left and below, are as possible with flash as with bulky flood and spot equipment.



Three flash lamps, one of them for back light, were used for each photo. All three were synchronized with the camera shutter.



Photo courtesy G. E.

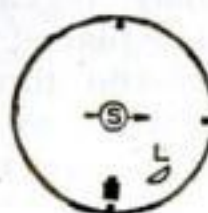


Photo courtesy of Kalart Co.

sunlight alone. To achieve this result, accurate lighting balance is essential.

If the technical characteristics of the flash lamp are understood, you can exercise a very sensitive control over its effect by the choice of shutter speeds and diaphragm openings. It is also entirely practical to control light intensity, under all ordinary conditions, by varying the distance of the lamp from the subject.

When the lamp must be fixed on the camera, a handkerchief or other diffusing material will reduce its brightness. You can determine for yourself the amount of diffusion necessary, since it depends almost entirely on the distance between the flash lamp and the subject.

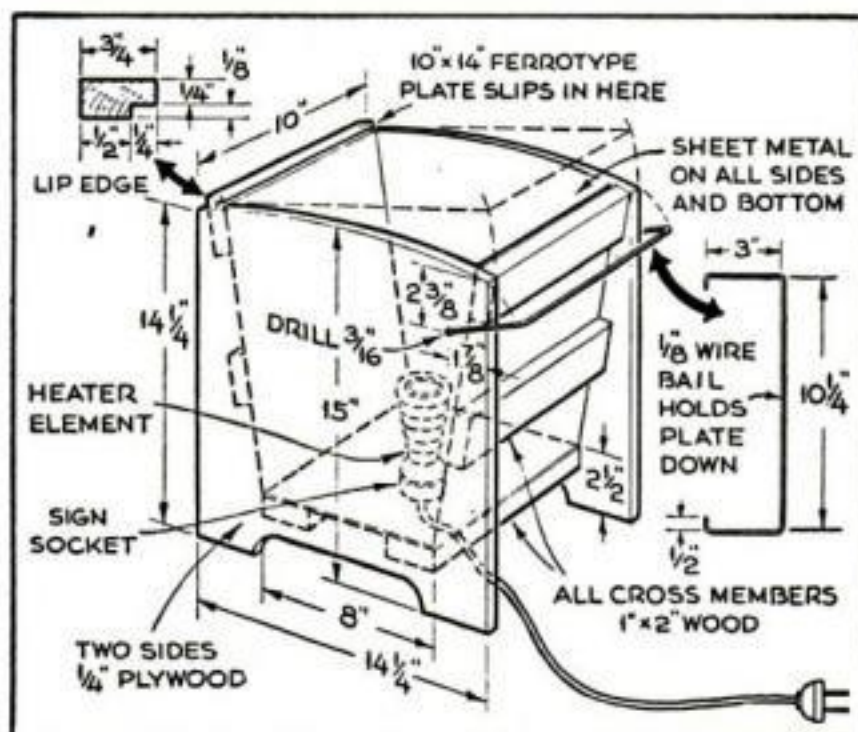
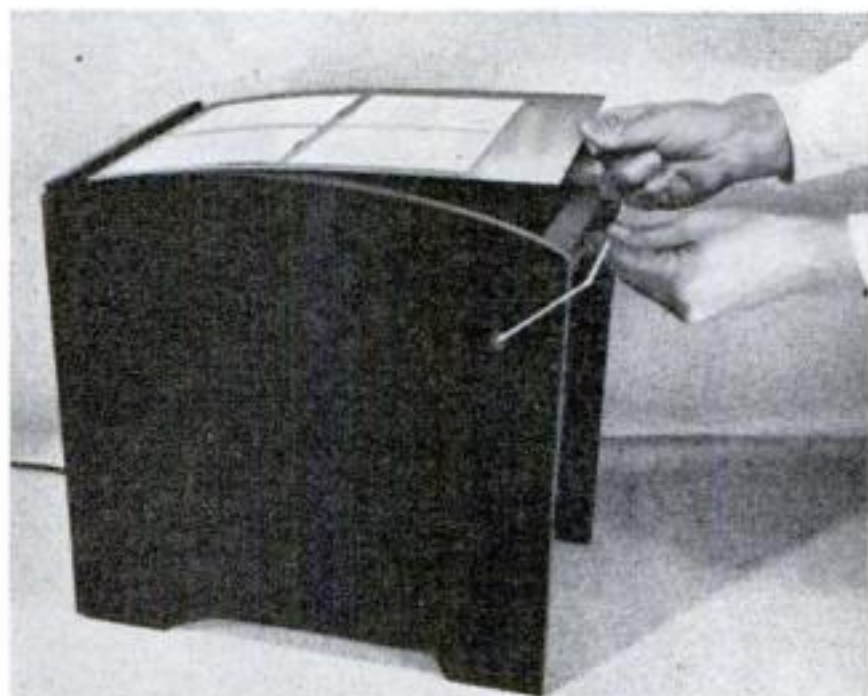


Well-exposed stop-action pictures are obtained in high-speed photography by synchronized flash. One lamp on an extension cord was used for that at left.

**POPULAR SCIENCE**



# Fast-Acting Print Drier of Plywood and Tin



EVERY amateur photographer can use a means of drying his prints in compact space and without undue delay. The drier shown above meets these requirements. Used with a big lamp bulb or a small heater element and a 10" by 14" ferrotype plate, it will dry a print or set of prints in less than 10 minutes, and they will slide off of their own accord. In an evening of production printing, it will practically dry prints as fast as they can be made.

Saw the two sides to shape from thin plywood, line with sheet metal or tin-can stock from a 5-gal. can, and drill the  $\frac{3}{16}$ " holes for the bail. Cut the sloping sides from more sheet metal or tin-can stock, tack them to crosspieces, and nail through the plywood into the crosspiece ends. Make up the bottom also from sheet metal, mount in it a porcelain electric socket, and nail it in place. The socket should be of the type

having terminals in the bottom so the connecting cord won't be exposed to direct heat.

Make up the lip edge and nail it on. Shape the bail from No. 9 fence wire or similar wire about  $\frac{1}{8}$ " thick and snap it in place. Paint only the outside of the box.

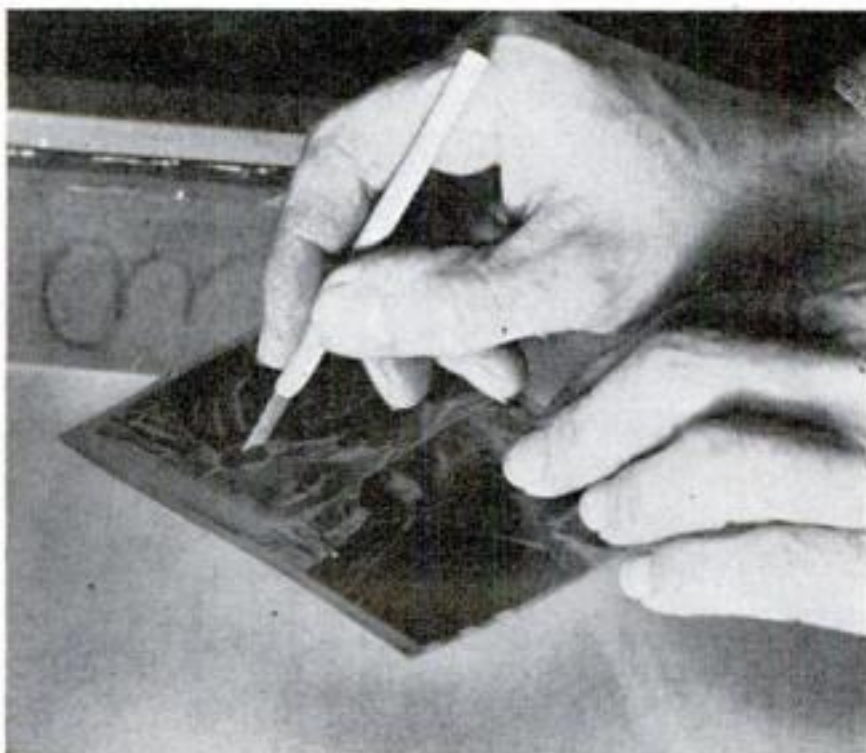
To use the drier, plug the cord into a house outlet, insert one end of the ferrotype plate under the lip edge, bend the plate to the curved sides, and hold down the other end with the bail. Then squeegee one or more prints on. The drier does the rest.

A canvas hold-down isn't necessary for the prints, but it can be added if you wish. Canvas 10" wide and approximately 17" long is required. Tack one end to the lip edge. A thin strip of wood inserted in a seam sewn in the opposite end will keep the canvas spread tightly from side to side. In use, the hold-down is stretched over the plate and held by the bail.—JACK MELLINGER.

## Retoucher's Etching Knife Fashioned from Scrap Tool Steel

FOR a sharp knife for retouching prints and negatives, anneal a scrap of discarded saw blade or similar tool steel and cut off a  $\frac{3}{16}$ " by  $1\frac{1}{2}$ " strip. Grind one end at about a 45-deg. angle and bevel one side of this diagonal to a sharp edge. The bevel should be on the side from which you naturally work. Drill two rivet holes in the opposite end about  $\frac{3}{8}$ " apart. Then harden and temper the cutting end. Hone to sharpen and leave a wire edge.

The handle may be a length of  $\frac{1}{4}$ " maple dowel. Slot and shape about 1" of one end and drill rivet holes to match those in the blade. Or it may be easier to drill the handle before drilling the blade so the holes in the blade can be spotted. Use cut-off brads for rivets.—W. E. B.



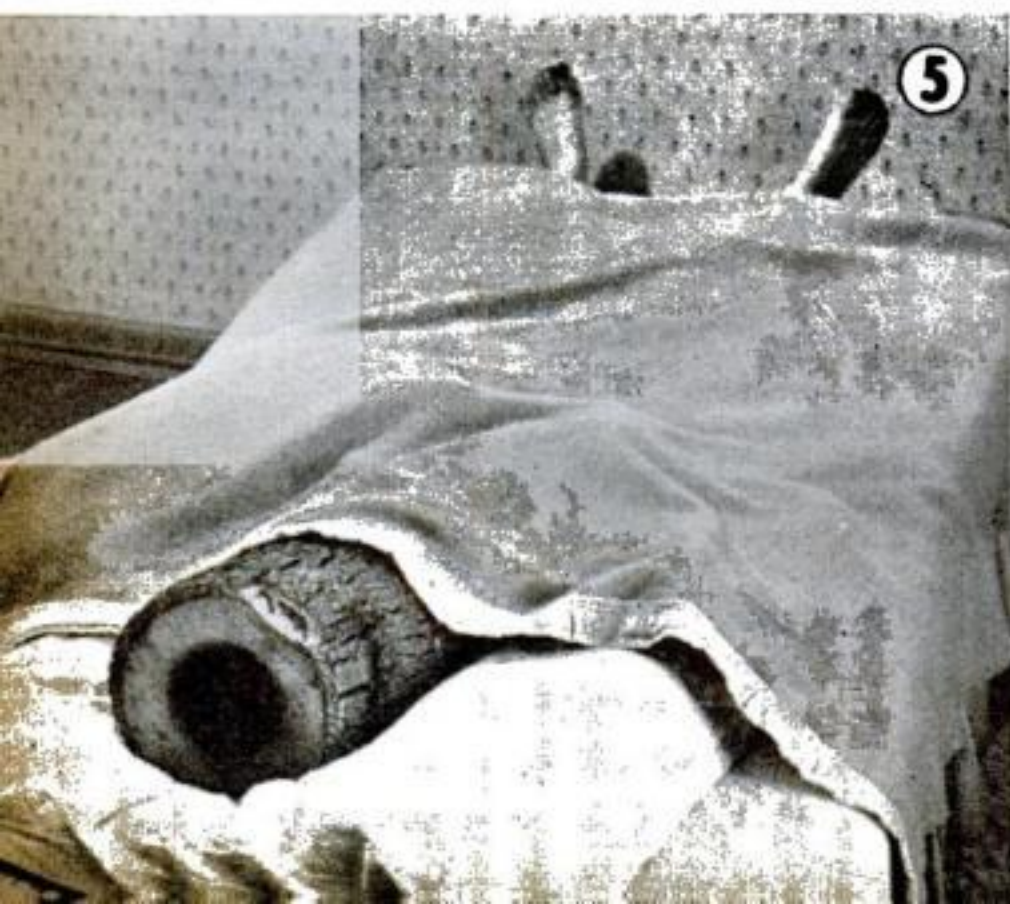


# Photo-Charades

## Picture

## Familiar Phrases

HERE is a new guessing game that camera fans can take up as their own. The pictures illustrate phrases and expressions in our everyday language. Answers are given upside down below. If you'd like to try your hand at some, POPULAR SCIENCE will pay \$5 apiece for acceptable photo-charades sent with the answers to the Photo-Charades Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y. None will be returned unless accompanied by a self-addressed, stamped envelope.



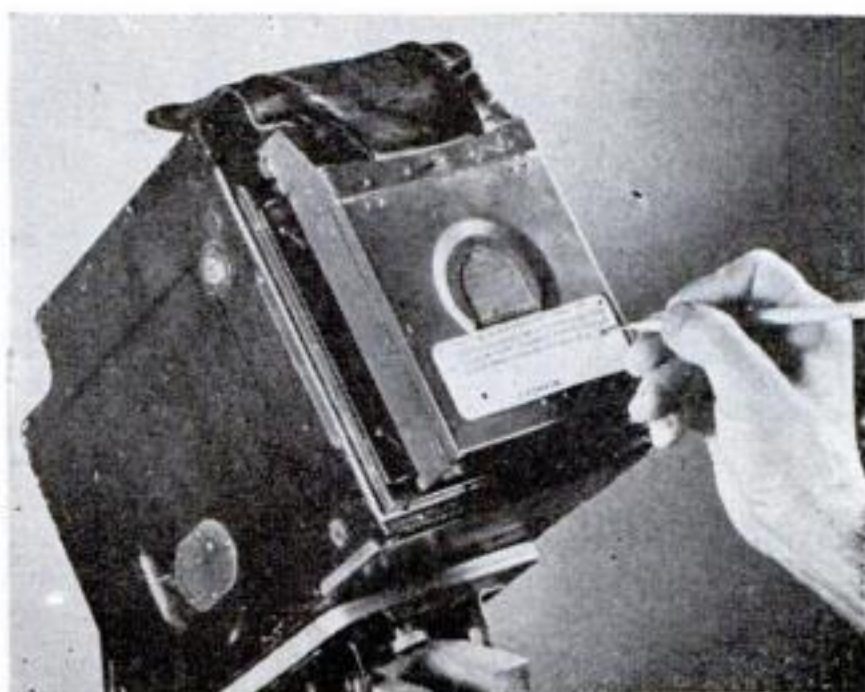
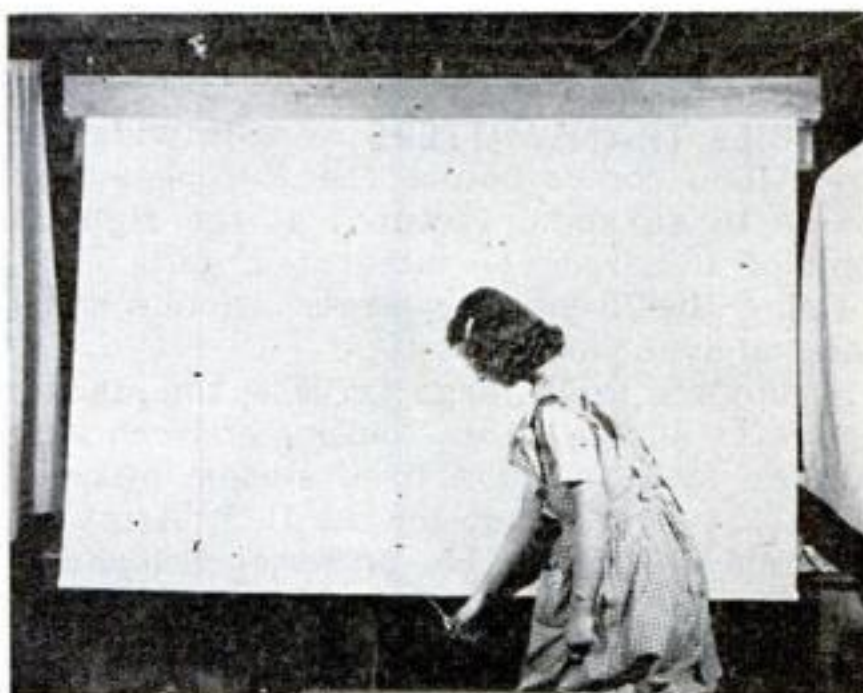
### ANSWERS

1. Eating a light meal.
2. Sick as a dog.
3. All wrapped up in her work.
4. Like a bolt from the blue.
5. Sleeping like a log.



## — PHOTO IDEAS —

**WINDOW SHADES** in the larger sizes provide convenient backgrounds for home photo studios. The 6' by 6' shade at the right is mounted inside a rectangular wooden box, the bottom of which is fitted with hinges and screen-door hooks. After use, the shade is rolled up and the cover closed to keep out dust. Such a background can be either mounted permanently or hung up as needed.—HARRY F. LEEPER.

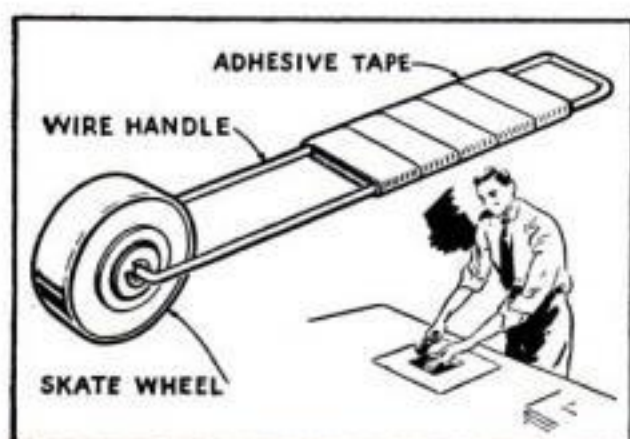


**EXPOSURE DATA** can be quickly penciled on a sheet of plastic or white celluloid that has been rubbed with fine sandpaper or pumice and attached to the film magazine. The notations resist considerable rubbing, but a damp cloth washes them off. Attach the plastic or celluloid by drilling and countersinking the corners and then drilling matching holes in the magazine back. Clinch  $\frac{1}{4}$ " brass wood screws over inside.—E.M.L.

**LENS-DUSTING BRUSHES** may collect grit and cause scratches unless carefully stored. An olive jar with a screw cap is excellent for this. Remove the cardboard disk from the cap, cut a hole so the disk slips snugly on the brush handle, and cement it fast. Then cut a larger hole in the cap and trim the disk to permit it to slide easily into the cap. The disk does not interfere with use.—W.E.B.



**THREE NEW DEVELOPERS** are being produced by the Eastman Kodak Company—Kodak Dektol, which eventually will replace Kodak D-72 for papers; Kodak Versatol, an all-purpose preparation for films, plates, and papers; and Kodak Microdol, for fine-grain film and plate work. Dektol, at present available only in professional sizes, is said to remain free from sludges or precipitates, allowing the operator to see the photographic image clearly throughout the life of the developer. Versatol, which also offers clarity in use, is added to varying parts of water, depending on the work processed. Microdol replaces Kodak DK-20 and DK-20R.



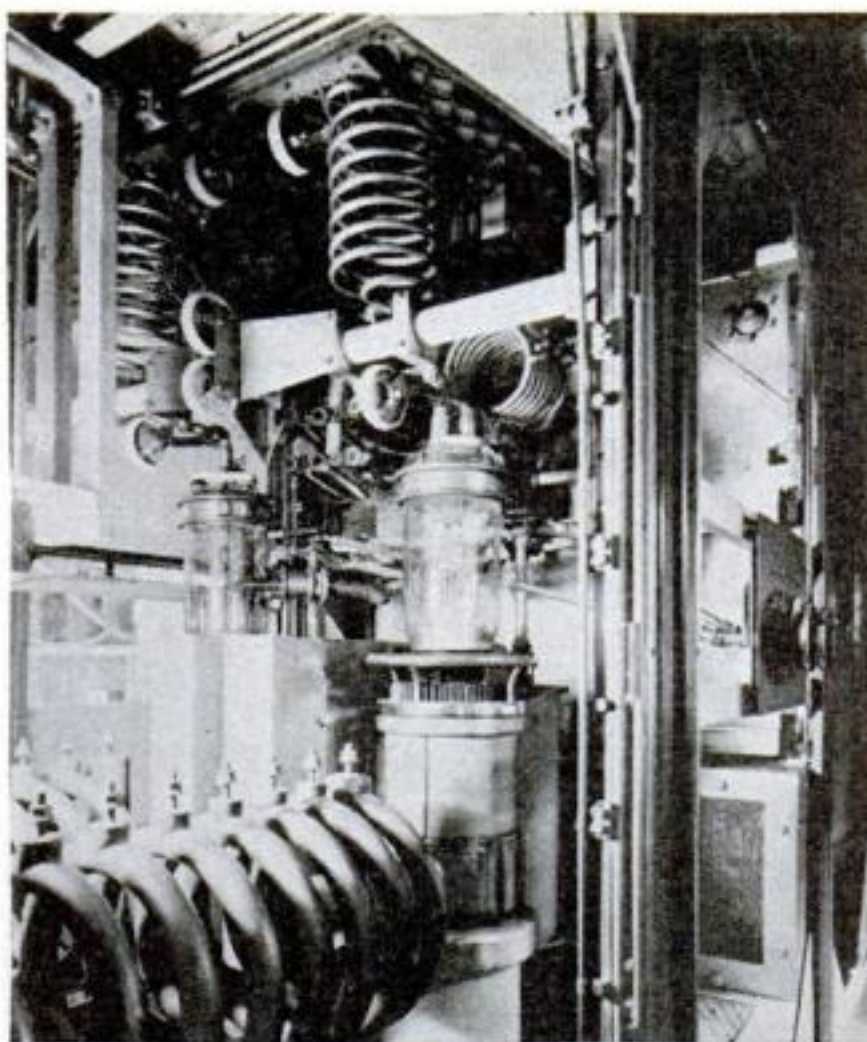
**A SKATE WHEEL** rotating on a wire frame is an excellent ironer for affixing photos in an album with dry mounting tissues. Such a wheel gives better control in pressing small areas than a flat iron, ordinarily used for such work. A U-shaped handle can be formed from heavy wire, the ends being bent in as axles. Wrap a thick coating of adhesive tape across and around the handle to hold it together and provide insulation when the ironer is hot. When the wheel is to be used, heat it in an open flame. Always test the hot wheel on a newspaper before applying it to a photo.—F.S.



# radio ideas

**MOBILE TRANSMITTERS** were in wide use by Allied forces before the European war came to an end. Pictured at the right is one of hundreds of integrated units comprising SigCircus, the largest mobile radio station ever built.

Complete in 17 large trailers, the station operates with a 60-kw. output and contains all the facilities of a fixed station of comparable power. Built for the U. S. Army by a French company, *le Materiel Telephonique*, SigCircus has full broadcast facilities in addition to radio-teletype channels and equipment capable of handling 200,000 words a day. Other features include facilities for transmitting and receiving pictures. The station can be put into full operation in about 24 hours.



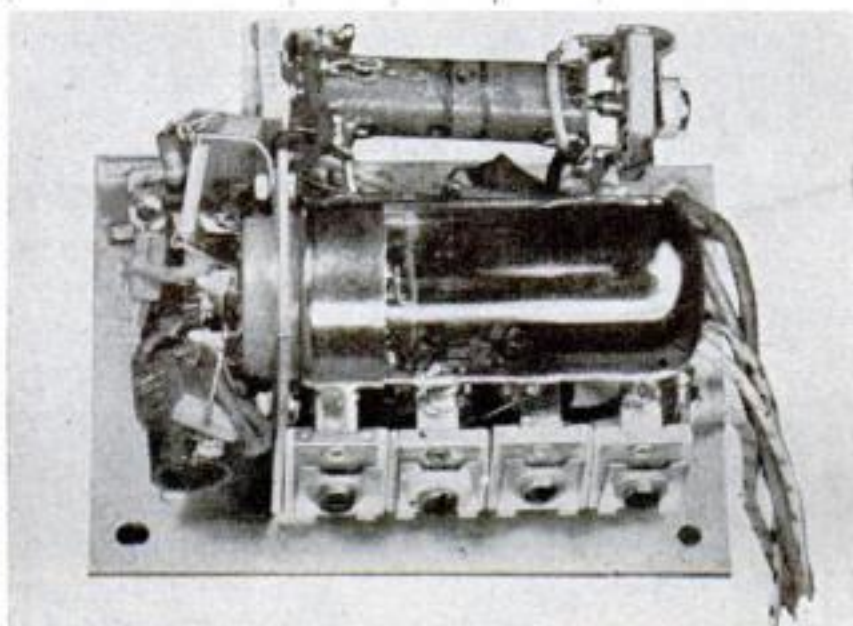
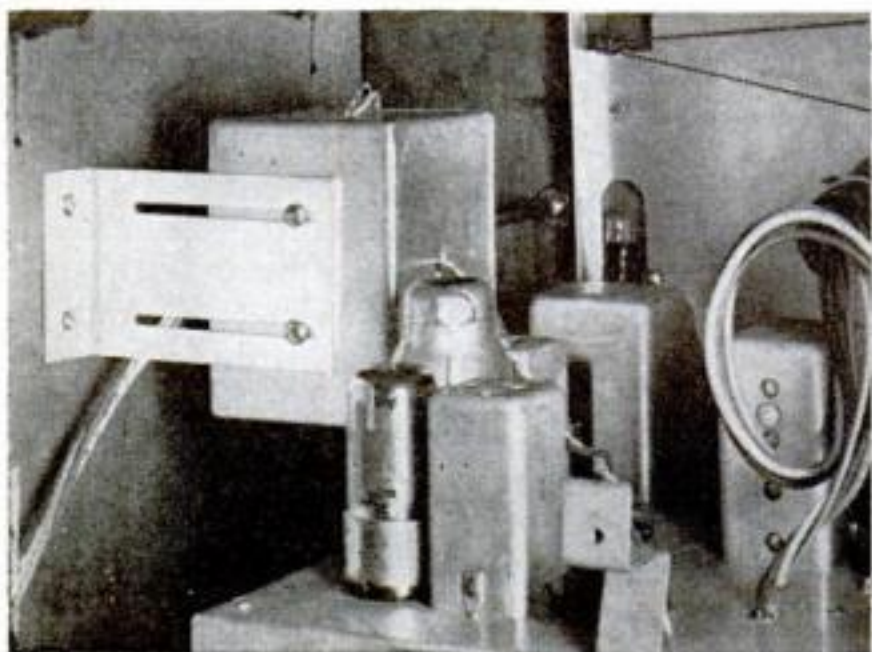
**THEY'RE COMING BACK**—looking much the same as before they went away. Planning for a smooth transition to peacetime production, Emerson Radio & Phonograph Corp. has announced the features likely to be included in its forthcoming models. At the left is shown a compact table set similar in appearance to the company's prewar product and priced at about \$25. Although improvements in design are projected, no details were released. Other models are a phonograph combination, a portable and a pocket receiver.

## WILL F.M. SETS BECOME OBSOLETE?

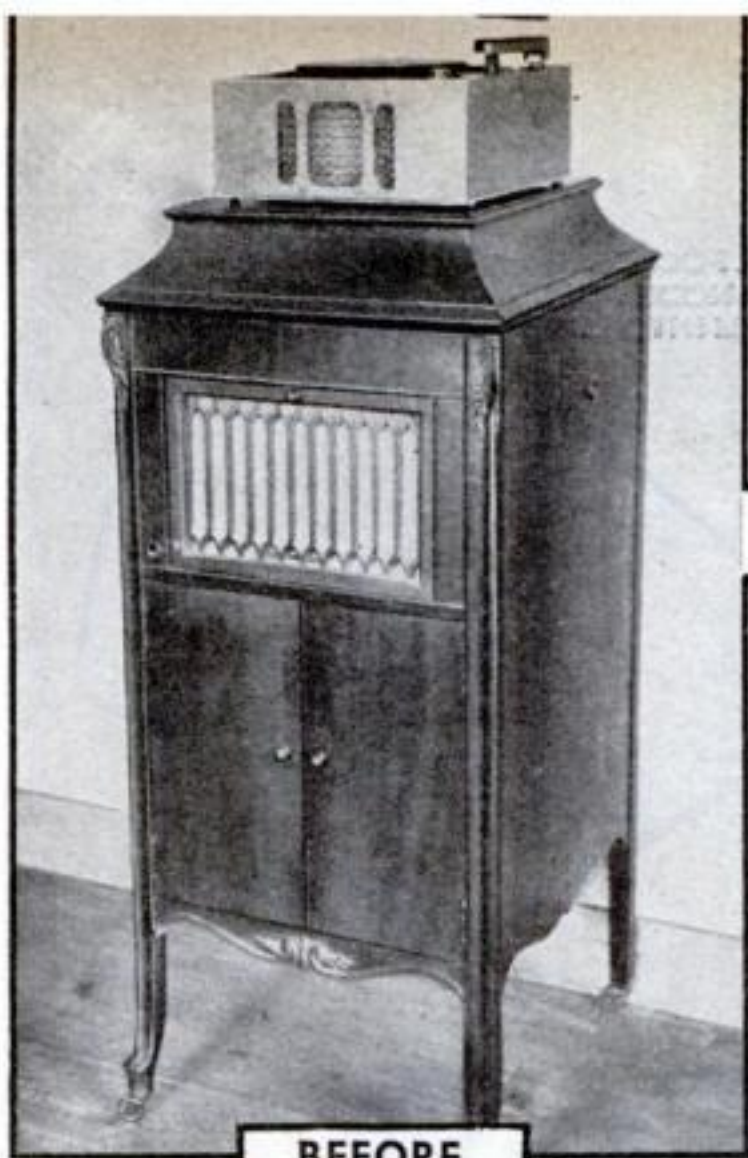
Discussion of what will happen to present-day frequency-modulated receivers has delayed the Federal Communications Commission in moving the F.M. band to a higher frequency range. One answer to the question is given by the Hallicrafters Co., of Chicago, in demonstrating their one and three-tube converters pictured below. The former, which can be attached inside the

cabinet without harming the appearance, is designed for use where signal strength is high. Tuning is done with the receiver dial. The three-tube converter will be used where it is necessary to boost the incoming signal.

While claiming that it will save many sets from the scrap pile, Hallicrafters' engineers point out that converters do not offer the final answer to reception in the projected 84 to 102-mc. band.







BEFORE



AFTER

## Old Phonograph Plays a Different Tune

CONVERSION of an old-fashioned phonograph cabinet into a handsome low-boy record player of convenient armchair height is a project that requires few tools and little skill. The turntable, pickup arm, motor, and amplifier from a small electric phonograph were installed in place of the hand-winding mechanism of the old phonograph to modernize its operation. A new and larger speaker was also obtained and mounted on a baffle in what had been the record-storage compartment.

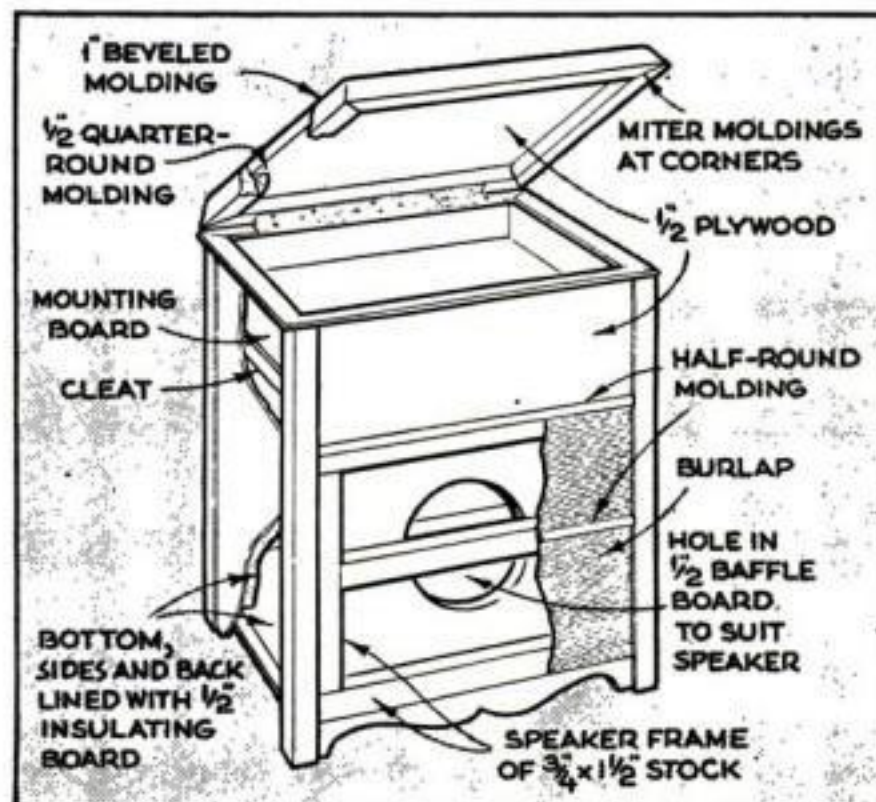
The doors and record racks were removed from the cabinet shown, and the legs were cut short. A plywood panel was substituted for the speaker opening in the upper third of the front, the cabinet was lined with insulation board, and the speaker and baffle, which was also cut from insulation board, were mounted in the lower two thirds as indicated. The opening was then covered with burlap. Molding strips tacked across the front helped the appearance. A series of  $1\frac{1}{2}$ " holes bored through both the insulation and back board near the bottom will improve the tone.

The mechanism from the portable was mounted on plywood cut to fit inside the cabinet; it rests on cleats about 4" below the top. A new plywood top edged with beveled molding was attached.

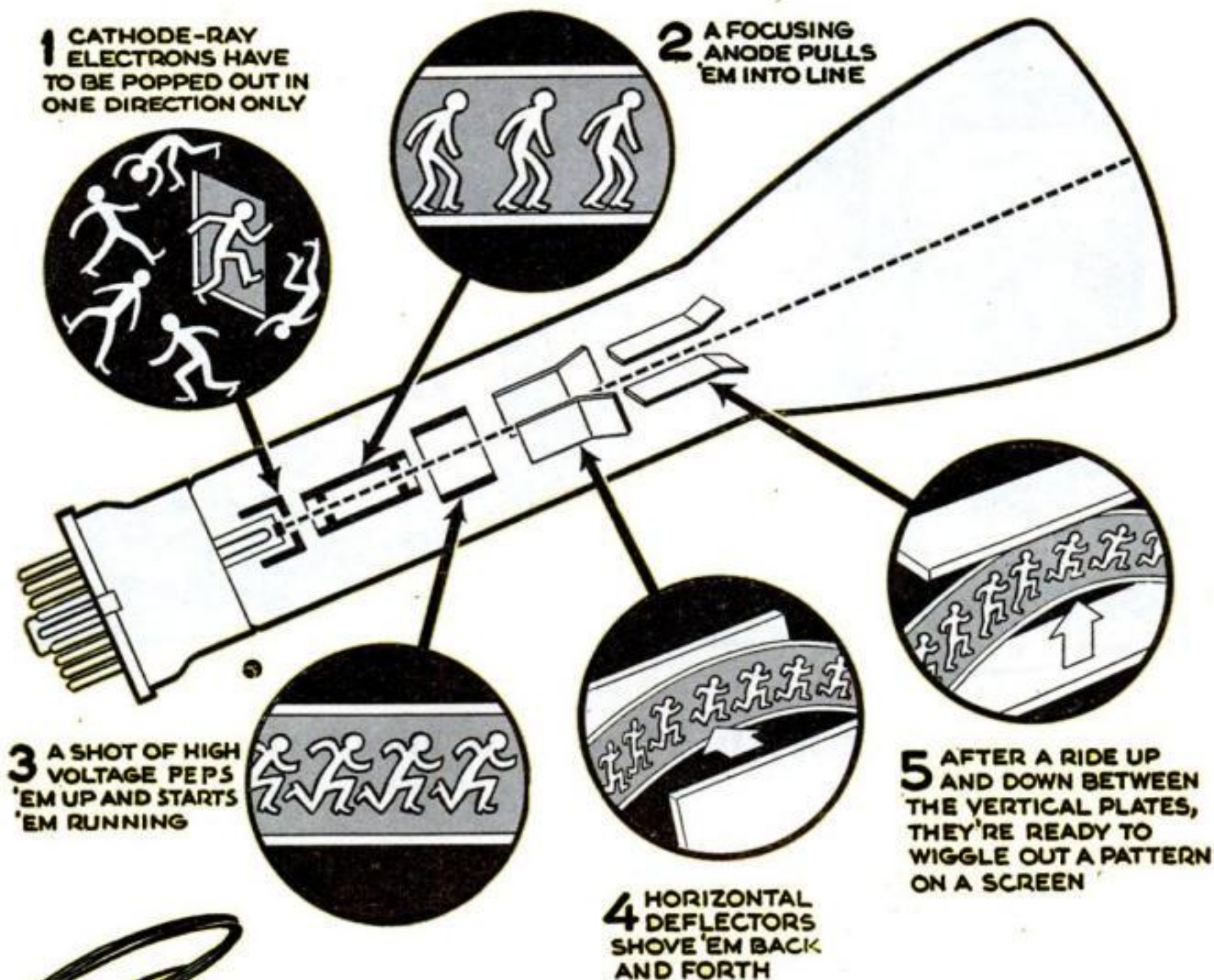
An antique finish was applied and stenciled decorations were added. The burlap was given a coat of thinned shellac before painting.—MARION E. WESP.



With the old cabinet as a base, construction is held to a minimum. A new and larger loudspeaker is housed in what once was the record compartment.







# Seeing Eye of Electronics

**MOST USEFUL AND VERSATILE OF ALL SERVICING TOOLS, THE CATHODE-RAY TUBE TRACES THE PATHS OF ELECTRONS FOR US**

**By John W. Campbell, Jr.**

**S**OME inventions become famous overnight while others seem to lie in storage for years on end, waiting for a chain of pioneers to push them upward into the light.

Cathode-ray oscillography, and, more particularly, the tube that is its eye and brain, falls into this class. Although it was invented nearly fifty years ago, at the outbreak of World War II the cathode-ray tube was still something of a rarity. Of course, the handful of oscilloscopes and television receivers in use all featured the miracle tube, but it remained for a mechanized war

to teach us that the seeing eye of electronics is the practically indispensable gauge of electronic movement—an almost pluperfect meter that can register everything that's measurable and even some things that aren't.

In 1897 Karl Braun, a German physicist, channeled the discoveries and inventions of a number of other scientists by producing an electrostatically controlled tube inside of which electrons could be made to trace a pattern on a fluorescent screen.

It didn't create much of a general stir except among the pioneers in radio, television, and electronics. How did scientists regard Braun's tube? The tip-off is that



in 1909 Braun shared the Nobel physics prize with Marconi.

Considered in only one of its aspects—as a servicing tool—the jobs that a cathode-ray tube can perform are almost endless.

Essentially the cathode-ray tube is a meter. Either as a voltmeter—the more usual test-device form—or as a milliammeter, it uses a practically weightless pointer capable of being deflected with enormous rapidity. The “pointer” can faithfully follow voltage fluctuations at frequencies as high as 200,000,000 cycles a second or react to direct-current potentials.

The “pointer,” of course, is a beam of electrons; it is made visible when the electrons strike the fluorescent coating at the end of the tube. Electrostatic focusing and deflection of the electron beam is common in the test-instrument type of cathode-ray tube, while television tubes employ magnetic focusing and deflection because a somewhat sharper focus can be obtained. When deflection is obtained by the magnetic field of a coil, however, there is an inductance load which tends to limit frequency response. Electrostatic deflectors represent a more nearly pure resistance load and can more readily be driven to very high frequencies. This article deals chiefly with the latter type.

An electron-emitting cathode, surrounded by a metal sleeve with a small opening, is the heart of the cathode-ray tube. The hole serves to define the electron beam and acts as an intensity-controlling grid. Two ring-shaped anodes draw out the electrons, accelerating them to high velocity. Because of the shape of the electrostatic fields between the control electrode and the focusing anode, and between the focusing and high-voltage anodes, the electron beam is drawn, as if shot from a gun, to a pin-point of light at the fluorescent screen, as shown in Fig. 1 on page 192.

Leaving the gun, the electrons move toward the screen at great speed. En route, however, they are pushed and pulled by the deflecting apparatus, causing the spot to move on the screen.

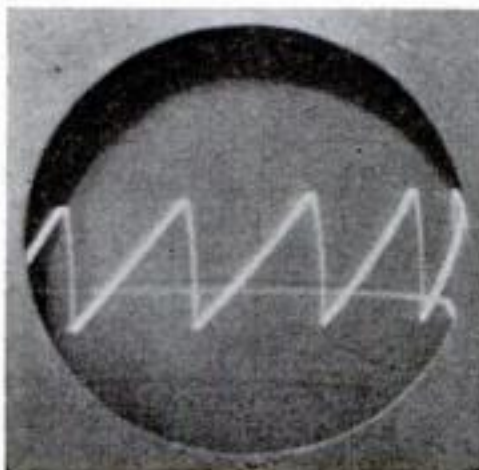


Size isn't everything in cathode-ray television tubes. RCA's postwar tube (right) is far brighter and more powerful than the prewar tube.

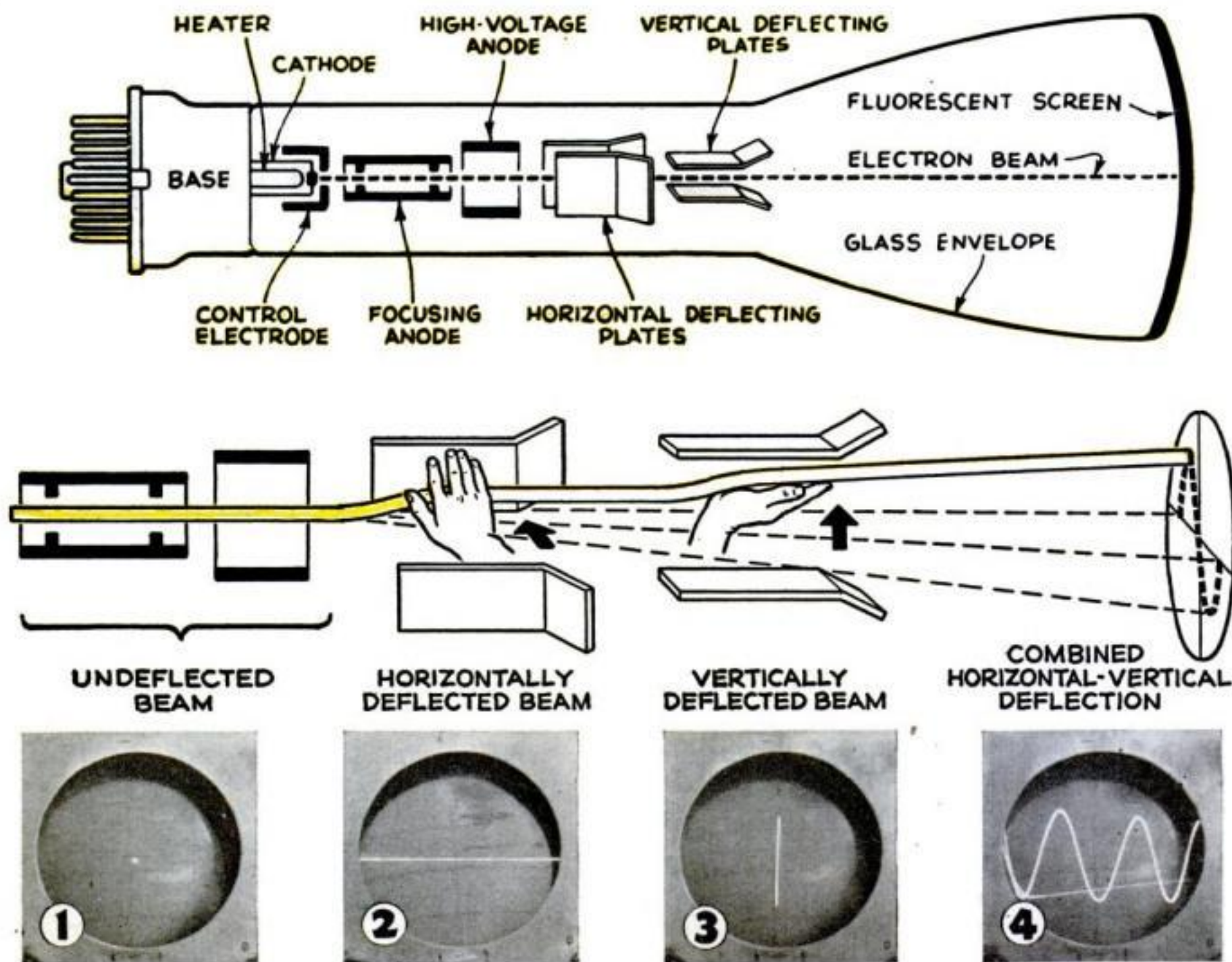
Just beyond the high-voltage anode the deflectors take over. The diagram shows the construction of a tube operated by electrostatic deflection. Two pairs of plates, mounted inside the tube, control the beam. One pair is mounted in a horizontal plane and deflects the beam vertically; the other plates lie in a vertical plane and deflect horizontally. If one plate of a pair is charged positive and the other negative, the beam will bend toward the positive plate—since the negatively charged electrons will be attracted to it—and away from the negative plate. By putting an alternating voltage on the plates they can be made to change from positive to negative and back again as often as the voltage alternates. If the charge is weak, the electrons will be moved back and forth only a short distance; if it is strong, they will swing across the screen from end to end. An alternating voltage applied to the horizontal-deflecting plates, then, will sweep the beam right and left at a rate equivalent to the frequency. The trace of this beam on the screen, however, will appear only as a straight horizontal line (Fig. 2) since each side motion only covers the trace of the preceding electrons.

When a signal is applied to the vertical-deflecting plates, exactly the same effect takes place except that the trace is perpendicular to the horizontal trace, as shown in Fig. 3. If, however, alternating voltages

Sweep voltage generators used in oscilloscopes produce sawtooth waves that build up to a peak and then drop to zero almost instantaneously.







are simultaneously applied to both pairs of plates, so that as the spot moves across the screen it also moves up and down, then the electron beam will trace out a visible pattern (Fig. 4) representing the relationship of the two voltages applied.

The cathode-ray tube itself is rather insensitive. Some with screens 5" in diameter operate with 1,200 to 1,500 volts between cathode and high-voltage anode. When electrons are accelerated by such high voltages, they move with enormous speed. Fairly heavy potentials are therefore needed on the plates to cause adequate deflection. For a standard 5" tube, about 400 volts swing is needed to drive the spot completely across the screen. In checking the performance of a radio transmitter or the power stage of an audio amplifier, sufficiently large voltages are normally available and the tube can be directly connected. But for most work deflection voltages must be amplified, and amplifiers are therefore built into test instruments such as the oscilloscope.

An oscilloscope is a test instrument built around a cathode-ray tube. By means of it you can amplify and feed a signal onto

either the horizontal or vertical deflectors.

Usually the test signal is applied only to the vertical-deflecting plates of an oscilloscope, while horizontal movement is obtained by means of a sweep-frequency generator, which usually operates in direct proportion to elapsed time. At the bottom of page 191 is a picture of a sweep voltage as recorded by the cathode-ray tube; it is obtained by means of an accumulation of a charge on the plates of a condenser connected across a control tube. This charge builds up at a uniform rate, reaches a peak, and discharges almost instantaneously. The "almost" is important because the very slight time required for the spot to return to its starting point introduces some distortion. For most practical uses, however, the fly-back time can be discounted.

Three basic factors account for the immense utility and adaptability of the cathode-ray tube as a test instrument: first, it is a double vacuum-tube voltmeter which gives a direct, visual indication of *instantaneous* voltage. Second, being double, it can indicate the instantaneous value of one voltage while simultaneously indicating the instantaneous value of a second, separate



voltage. Third, comparatively simple electronic circuits can be devised to measure any given quantity, quality, or property in terms of voltage.

This last factor may not look impressive, but its importance is almost beyond estimate. A photoelectric cell readily converts light intensity into voltage; a microphone converts sound-wave pressure into voltage; a Rochelle salt or quartz crystal converts mechanical pressure into voltage; a mechanical setup of a rocking prism, a small motor, and a motor-driven variable resistor can produce a voltage proportional to the color of light allowed to fall on a surface; two small coils and a bar of metal will produce a voltage characteristic of the magnetic properties of the bar of metal, and those magnetic properties are dependent upon the alloy content of the metal, its past history of heat treatment, mechanical treatment, and temperature. The list could be continued indefinitely—in fact, there is no known quantity that cannot be measured in terms of voltage. Humidity, X-rays, oxygen, hydrogen, nitrogen, or the gas content of any sample can be measured electrically. Even the intensity of human emotions can be measured in terms of voltages!

But the cathode-ray tube paints a visible picture of how one voltage varies with respect to another. If the sweep voltage—the one causing the horizontal deflections—is generated by a relaxation oscillator, the spot will move from left to right at a steady rate. The horizontal axis, then, will represent time. If an audio-frequency signal is applied so as to cause vertical deflection, the resultant trace on the screen will be a graph of instantaneous voltage vs. time. This very capacity to compare any two things expressed in terms of volts makes the cathode-ray tube the most universally applicable, the most adaptable, of all servicing tools. Since it is inherently a vacuum-tube voltmeter, it is ideal as an output meter. But since it can both measure the

amplitude of a wave and determine the shape of that wave, unlike ordinary output meters, it can also act as a distortion meter.

By using the cathode-ray tube in conjunction with a frequency-modulated signal generator, set alignment of an accuracy otherwise impossible becomes simple. The horizontal sweep (time) is tied to the frequency modulator in such a way that the horizontal displacement of the spot represents frequency. The vertical sweep is supplied by the output of the audio system of the set under test. If you were aligning the 456-kc. intermediate frequency, the frequency-modulated signal generator would be set to generate 456 kc. plus and minus about 15 kc.

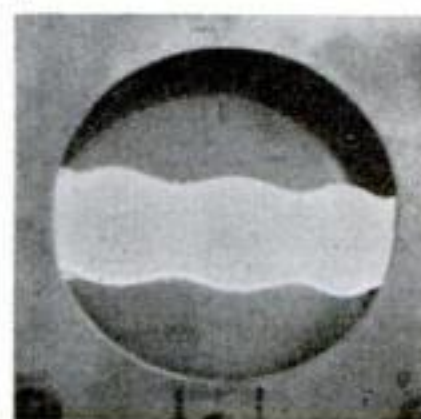
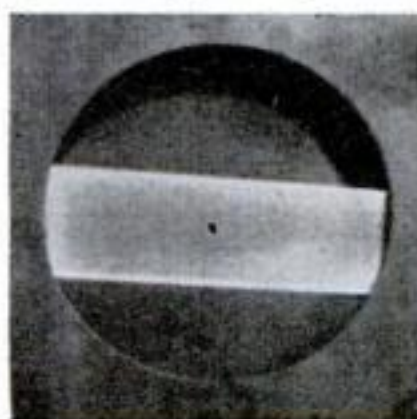
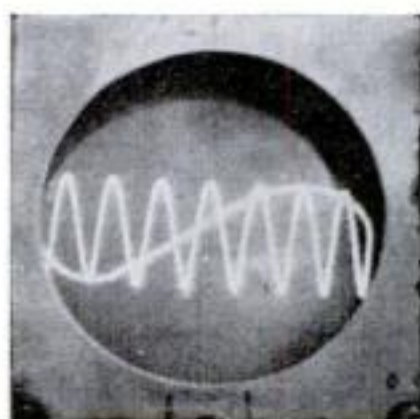
In a properly aligned set, maximum audio-frequency output would appear as the signal passes through 456 kc. In any case, the resultant pattern on the screen is an accurately plotted response curve. Where alignment is incorrect, there may be two, three, or more minor humps. As the trimmers are adjusted, these minor humps are seen to slide along, coalesce, and finally build the properly peaked curve of exact alignment.

An output meter and ordinary signal generator can do fairly well on this job with an ordinary set, but when double-peaked intermediate frequencies are used in broad-band, high-fidelity superheterodynes, the output meter won't do the job. An oscilloscope and F.M. generator are the only team that can properly align an F.M. set.

For tracking down and curing distortion in an audio amplifier, the cathode-ray oscilloscope is the instrument of final authority. With it you can see the distortion. It draws its own portrait, and by its type and form tells you where to look and what type of correction to make.

There is a simplified, small, green-glowing type of cathode-ray tube familiar to most people as the "magic eye." But it's the cathode-ray oscilloscope tube that is the real magic eye. It sees all, knows all, and tells all!

Here's the life story of an electric wave as told by a cathode-ray oscilloscope. Left, the harmonic-rich, highly distorted output of a 50-kc. multivibrator; when filtered, the signal becomes an almost pure sine wave. The greater number of peaks means a slower sweep voltage. When the sweep is lowered still further, we see a filtered but unmodulated R.F. carrier. Last, a 400-cycle signal is impressed on the carrier.





# Portable Dragsaw Feeds Hungry

By FRANK ROWSOME, JR.

A FIREPLACE can be a hard taskmaster, particularly if it's used to eke out limited amounts of fuel for the main heating system of a house. Capable of freeing you from periodic drudgery with crosscut and bucksaw, this compact power saw will keep the hungriest fireplaces satisfied, and without blisters and backache.

Power to run the saw comes from a one-cylinder, four-cycle gasoline engine rated at  $\frac{1}{2}$  hp. at 2,300 r.p.m. It is compact, weighs only 30½ lb., and was originally designed to run a washing machine. Fuel consumption is almost negligible, and the engine can be operated continuously without overheating. Any light, air-cooled, easy-to-start gasoline engine will do—preferably one with a muffler and a governor.

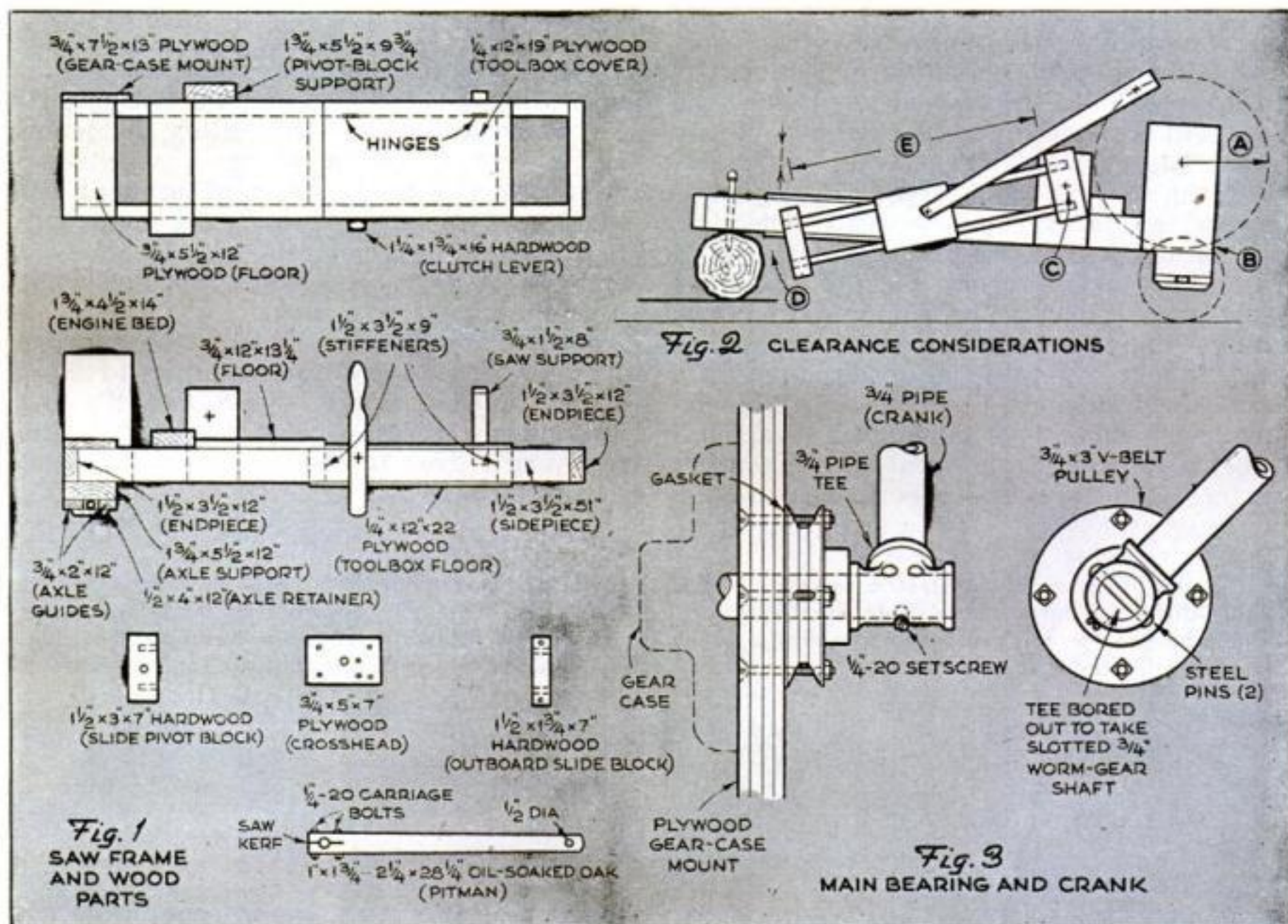
You will need a worm-gear unit to reduce speed to 60 or 80 r.p.m. for the crank that moves the saw. One taken from a junked washer may be obtained at a washing-machine repair shop, but examine it for excessive wear in bearings, worm, and gear, and try to obtain one with a complete hous-

ing. Further speed reduction can be gained through proportioning the pulleys on the engine and worm shaft. A 3" engine pulley, 4" worm pulley, and 25-to-1 gear ratio give the saw illustrated a crank speed of 69 r.p.m. at full throttle.

As shown in Fig. 1, the saw frame is a 1' by 4½' rectangle of 2" by 4" stock. It is assembled with carriage bolts and lag screws. Sturdy construction is necessary since it must absorb engine vibration and cranking stresses, and for this reason the lateral 2" by 4" stiffeners were added. Wheels at one end help when the saw is moved.

The transverse piece 1¾" thick serving as an engine bed is bolted to the frame. A similar upright acts as a mount on which the slide is pivoted, while a ¾" plywood upright is used as a mounting bracket for the gear case. Plywood panels, one screwed to the bottom and the other hinged across the stiffeners to the top of the frame, form a convenient toolbox.

Figure 2 shows some clearance problems that should be considered before construction is begun. The first measurement to de-



Saw frame and gear-case mount. Because case was open on one side, V-pulley was bolted on as a bearing.



# Fireplaces

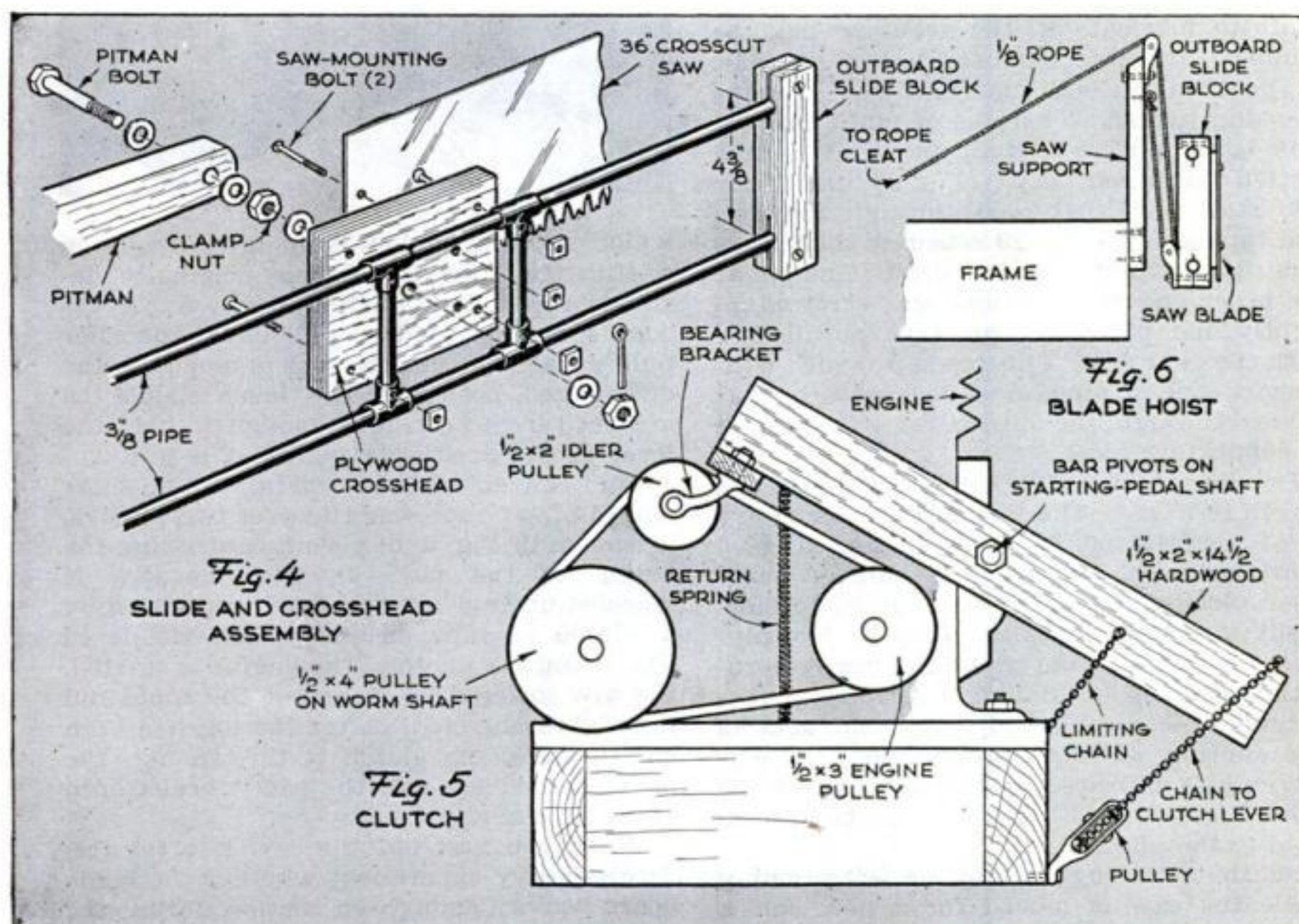
termine is *A*, which governs saw travel. It is  $9\frac{3}{4}$ " for the saw shown, giving a saw stroke of  $19\frac{1}{2}$ ". A longer stroke isn't necessary and might cause excessive vibration. Note that the wheel on the crank side must be located sufficiently outboard to let the crank pass at *B*. The inside length *E* of the slide is governed by the length of the stroke, that of the crosshead, and, to some extent, by the arc described by the slide. For the saw pictured, the inside slide measurement is 27".

Ideally, for minimum slide length and directness of cutting thrust, the slide should be pivoted at the crank. This wasn't practicable for the saw shown since the worm-gear shaft wasn't long enough, and the slide was accordingly pivoted at *C*. The result is a slight difference in crosshead travel when cutting begins on a log and that at the end, but the setup has been found satisfactory. Notice



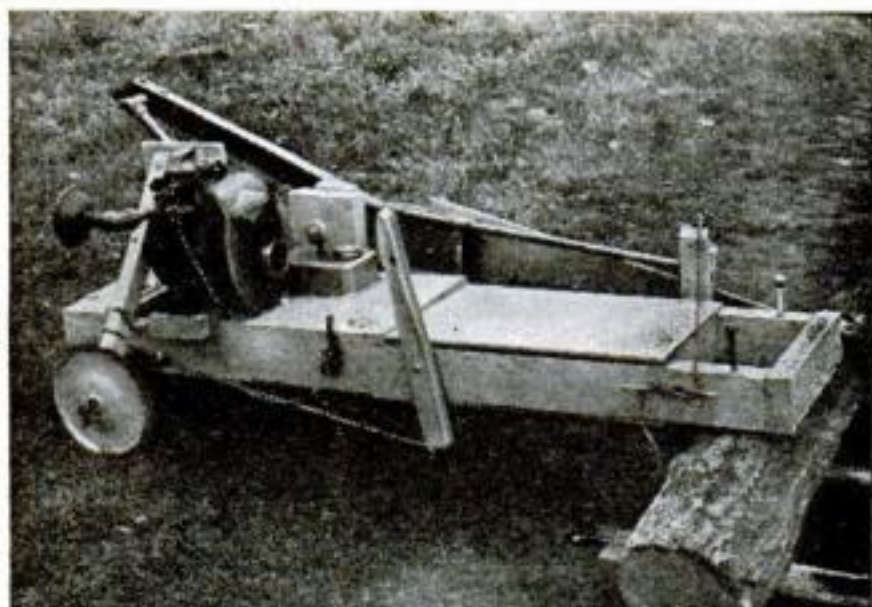
that *C* is on a line from the center of the crank to the center of a log of average size and is far enough away from the circle described by the crank to let the latter clear the pivoting block in all working positions. Leave sufficient space at *D* for the slide to drop past the largest log likely to be cut.

Use kerosene to wash grease from the



Details of the crosshead, slide, and clutch mechanism. A simple rope blade hoist lifts saw after each cut.





Spikes driven lightly into the log hold the saw frame fast. The operator works on the lever side.



Weighting at the end will improve cutting if the saw blade does not bear heavily enough on the log.

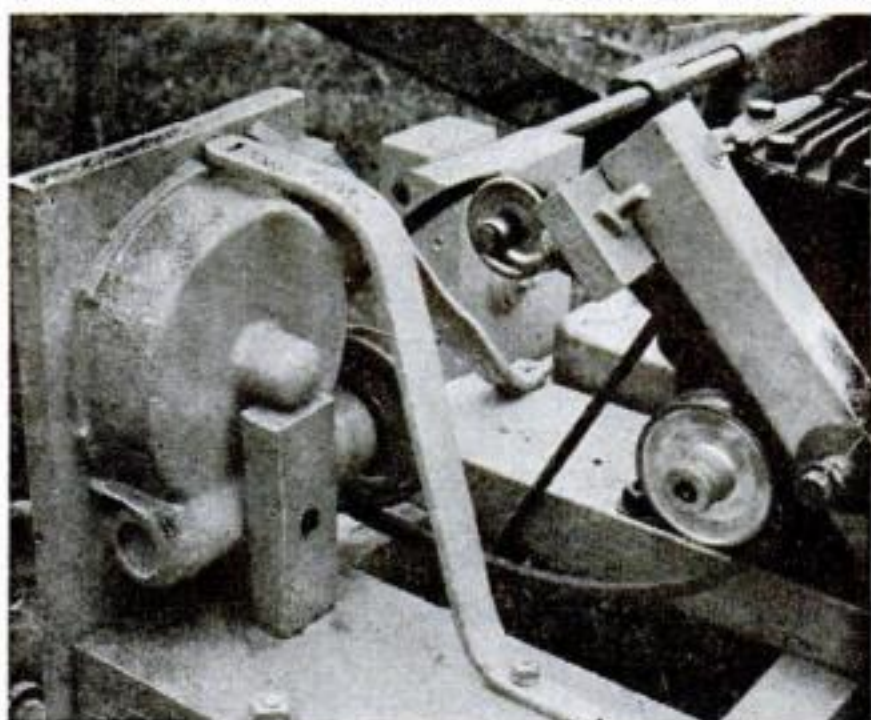
speed-reduction unit, and inspect the worm shaft for excessive end play, a means for the taking up of which is usually provided. Fill the gear case with heavy oil or a light, hypoid-type grease, and bolt it to the upright bracket. Since the unit shown was open on one side and lacked an outboard bearing, the case was bolted directly against the plywood bracket with a cork gasket to act as a grease seal. A die-cast V-belt pulley with a  $\frac{3}{4}$ " shaft hole was bolted to the outside of the mounting panel where it makes an excellent bearing (Fig. 3). While enough grease works out the slowly moving shaft to lubricate it, the setscrew may be removed and its hole used as an oil hole.

The crank is built up from two  $\frac{3}{4}$ " pipe tees and two short lengths of pipe. One tee was bored out to a light press fit on the slotted worm-gear shaft (Fig. 3), drilled for two steel pins that pass through the slot, and tapped for a  $\frac{1}{4}$ "-20 setscrew that bears in a dimple formed in the shaft. The tee at the other end of the crank was screwed on tightly and pinned to preserve parallelism with the gear axis. This tee is provided with a short stub of pipe, machined smooth, that passes through the oil-soaked oak pitman or connecting rod.

Details of the slide and crosshead are shown in Fig. 4. The former consists of two  $31\frac{1}{2}$ " lengths of  $\frac{3}{8}$ " pipe, mounted  $4\frac{3}{8}$ " apart between centers in a pair of hardwood blocks. Four pipe tees, bored to slide easily along the pipes and held by two nipples, form the actual guide for the reciprocating movement. Bolted to them is a rectangular piece of  $\frac{3}{4}$ " plywood that acts as a mounting surface for the 36" crosscut saw, which is bolted on through the handle holes. A  $\frac{1}{2}$ " by 3" bolt secures the crosshead to the pitman.

So that the engine may be left running while the saw is moved for a new cut, a simple clutch consisting of a movable idler pulley is provided, as in Fig. 5. The bar on

Below, a view of the worm-gear reduction unit and the clutch assembly. A heavy metal brace of the type shown will be helpful in lessening vibration.



which this idler pulley is mounted pivots on a stub shaft on the engine originally designed for a kick-starter pedal. A screen-door spring is used to pull down the idler pulley when the clutch lever is moved to the disengaged position. The lever should be attached by a bolt tight enough to hold the lever in the position in which it is left.

For convenience in operation, a short length of  $\frac{1}{8}$ " rope was run over two pulleys, as shown in Fig. 6, to permit controlling the height of the saw. In use, the saw is wheeled up to a log and fixed in position by a couple of taps on the spikes visible in Fig. 2 and the photos. The engine is started, the saw lowered by means of the rope, and the clutch engaged. After the log has been cut through, the clutch is thrown out, the blade hauled up, and the saw wheeled into place for a new cut.

When you first put the saw into service, determine by experiment whether the blade bears heavily enough on the log during the cutting. In the saw shown, a 4-lb. weight was affixed to the end of the blade.



# MAGIC YOU CAN MAKE

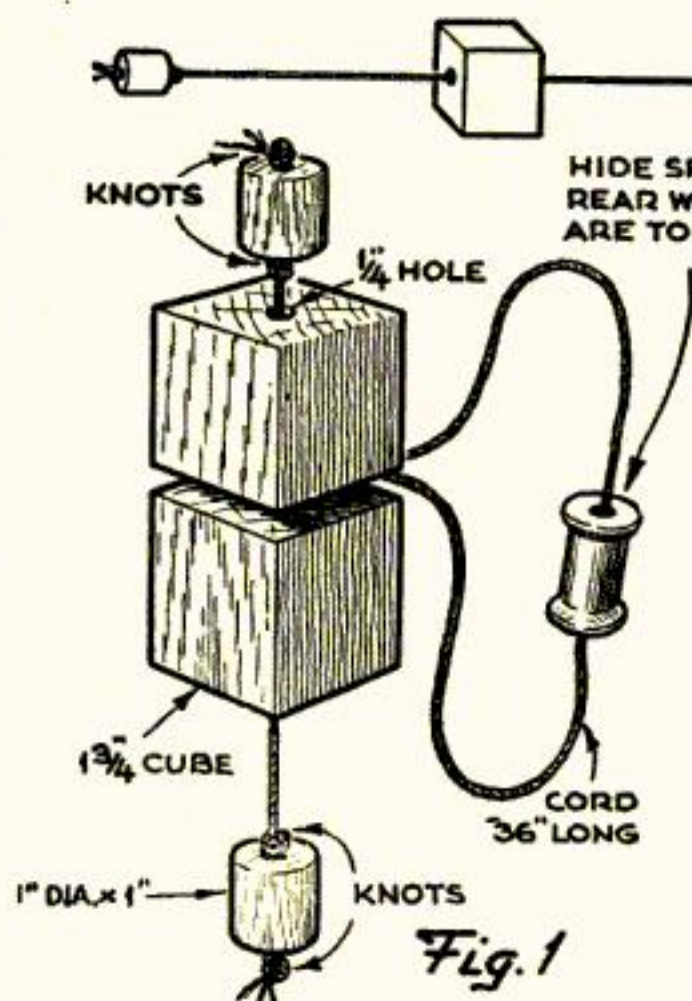


Fig. 1

HIDE SPOOL IN REAR WHILE BLOCKS ARE TOGETHER

Fig. 2

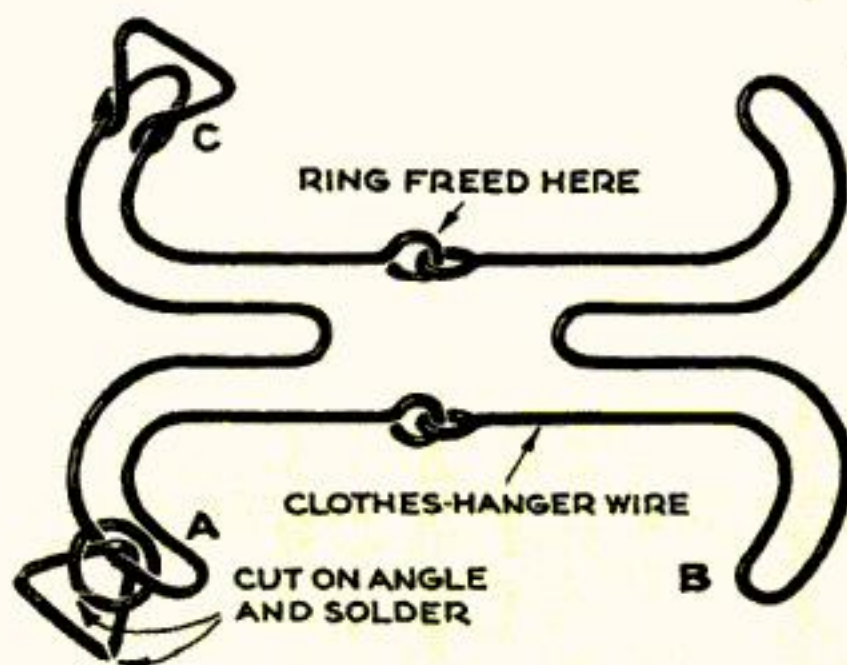
**THREADING A SPOOL** on a cord between two sets of blocks and spools already threaded on is not as impossible as it looks—if you employ a little legerdemain. In this case, of course, you have the spool already threaded in place, as shown in Fig. 1, but concealed by the hand.

Place a handkerchief over the trick and have someone hold the cord at each end. Then produce a free spool, say you will thread it between the blocks without having the ends let loose, and place it under the handkerchief with some obvious working of the hands. Conceal the free spool as you remove the handkerchief, and reveal the trick spool.—GEORGE BARR.



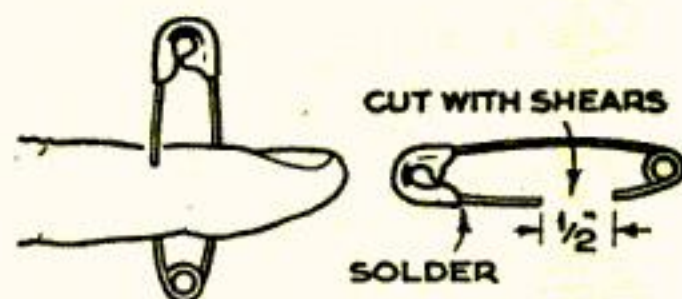
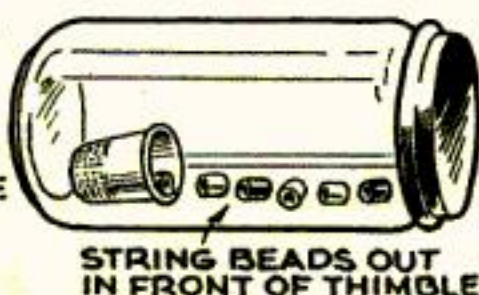
**WIRE PUZZLES** are always fascinating, partly because so many people can try them without succeeding. To remove the ring on this puzzle, first spread out the hinged crablike H-form and arrange the stirrup, ring, and triangle as shown in the drawing at right.

Now fold over the right side on the hinges so that A and B meet. Then pass the ring over both the ends and on up and around the loops and lower hinge, working it up to point C. There, if the stirrup is pulled out as shown, you can by-pass it and free the ring at the top hinge. Reverse the procedure to put the ring back on the wire.—G. B.



**THIS MAY TAKE HOURS**, but with a definite plan you can put the elongated beads into the thimble in two minutes flat—sometimes. Use a small baby-food jar and about 10 beads. The difficulty comes in getting beads past the thimble lip, so turn the jar upside down and then on its side, maneuvering the thimble toward the bottom. If even one bead goes behind it, start over.—G. B.

GLASS JAR  
2" DIA. x 3 1/2"  
FLATTEN  
BASE OF  
No. 12 THIMBLE  
10 BEADS,  
3/16" DIA. x 1/4"



**IT LOOKS PAINFUL**, this pin shown stuck through a finger—actually it is done without harm. Solder the point of a safety pin to its catch, and next cut 1/2" out at the center with wire cutters or a hacksaw. Slipped on a finger, the pin then appears to stick through.—G.B.



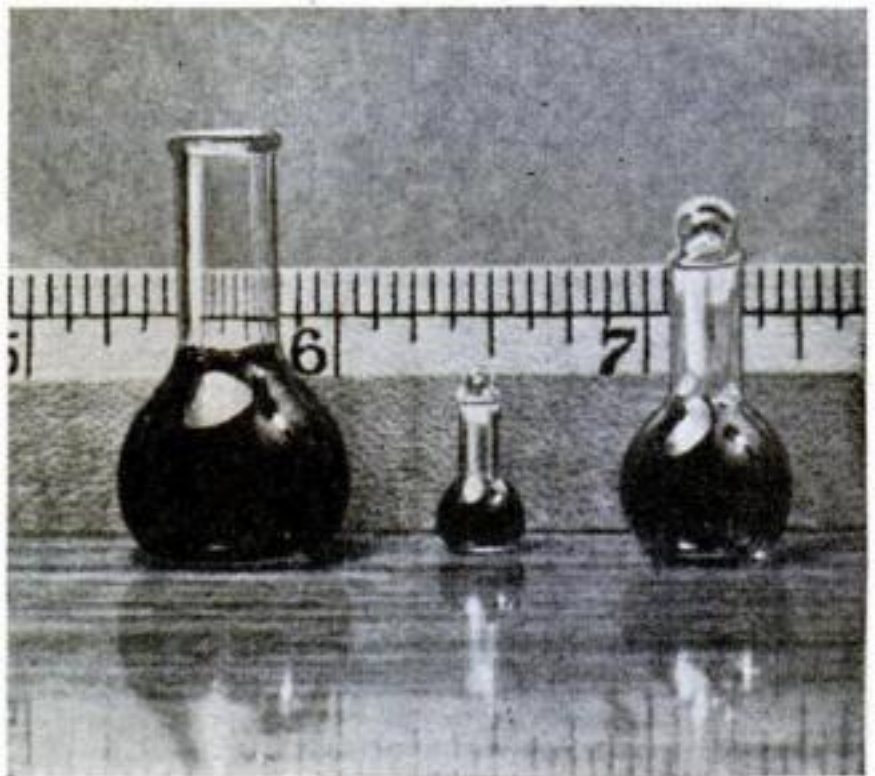
# GLASS BLOWING FOR THE

## Difficult? Not a Bit! Even Novices Produce Decorative Objects from Glass Tubing

**A**NYONE with breath enough to blow soap bubbles can also blow glass. This doesn't mean, of course, that the beginning glass blower will get perfect results at his first try, for the professional spends years winning the skill required to produce intricate glass articles. But with a little patience you will gain the basic skills.

Bubbles of glass are the basis of all hollow glassware. In a glass factory they are blown with an iron tube about 5' long called a blowiron or blowpipe. Beginners do not need such equipment. They can use glass tubing both as blowpipe and raw material and from it form many useful and decorative objects for the home and laboratory.

Only a few things are required—tubing made of soft soda-lime glass, a triangular file, a graphite or metal rod, smooth-jawed pliers, a small piece of asbestos, and a Bunsen burner. A pair of metal tweezers about

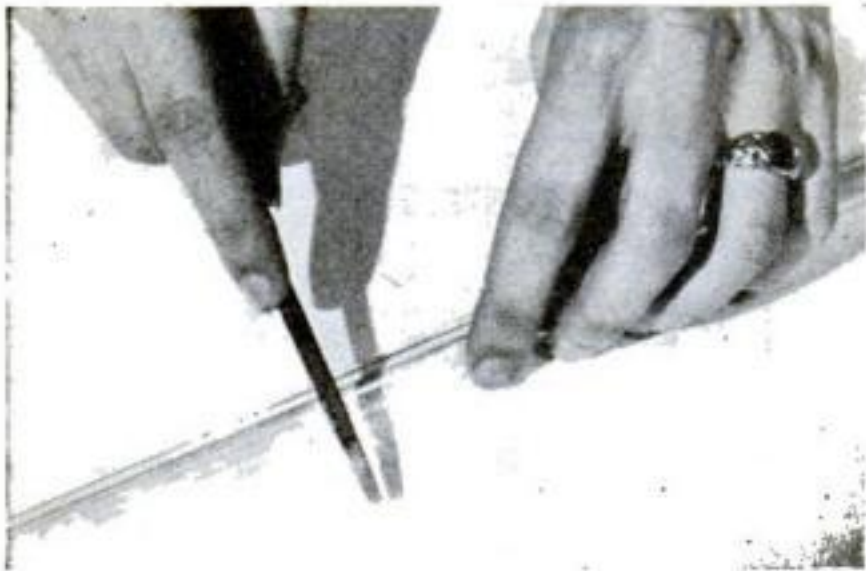


9" long will come in handy, and a fishtail attachment on the burner will make it possible to heat larger areas at one time, but these are not essential. If a Bunsen burner is unavailable, try a kitchen gas range.

Because molten glass flows like extremely heavy sirup, glass bubbles must be constantly rotated to keep them from sagging out of shape. Steady turning of a piece of tubing that is being heated also is necessary to insure even heating.

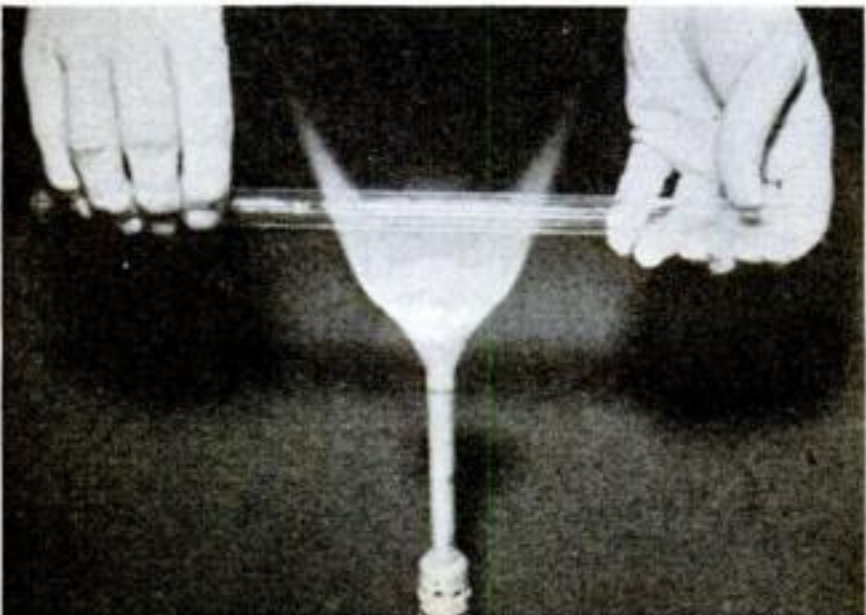
A small flask is an easy project with which to begin. Select a piece of tubing 8 or 10 mm. in diameter and cut off an 8" length by making a scratch with the file and snapping the tube. Next, concentrate the flame on a spot 3" from one end, and, when the glass is molten, pull the tube apart. Continue heating the pointed end of the larger piece until it has become a yellow-hot ball of glass.

Now quickly withdraw the tube from the flame, hold it in a vertical position with the melted end down, and blow steadily into the top. (Remember to rotate it!) The lower

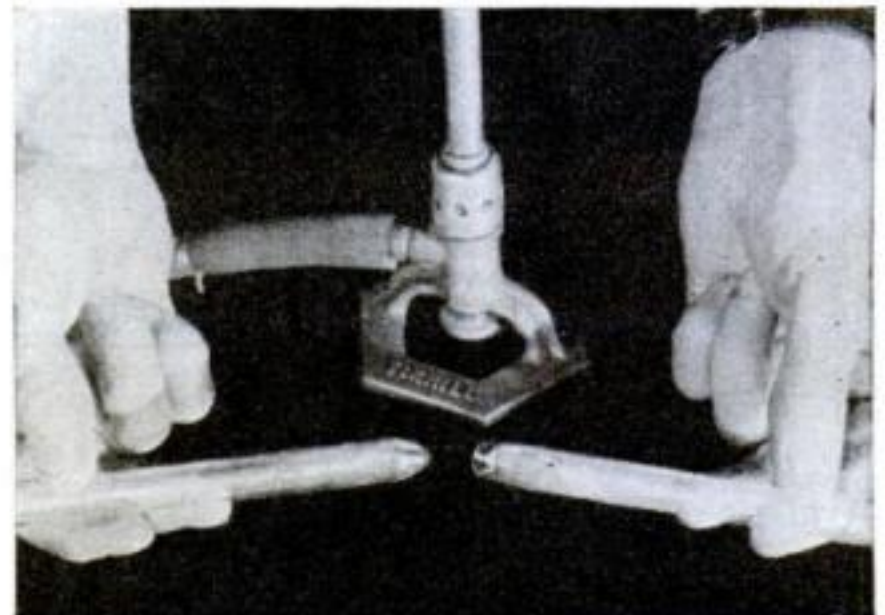


Glass tubing is easily cut to any length. Scratch it around with a triangular file and snap it off.

Constant turning is important while a tube is in the flame. This assures even heat on all sides.

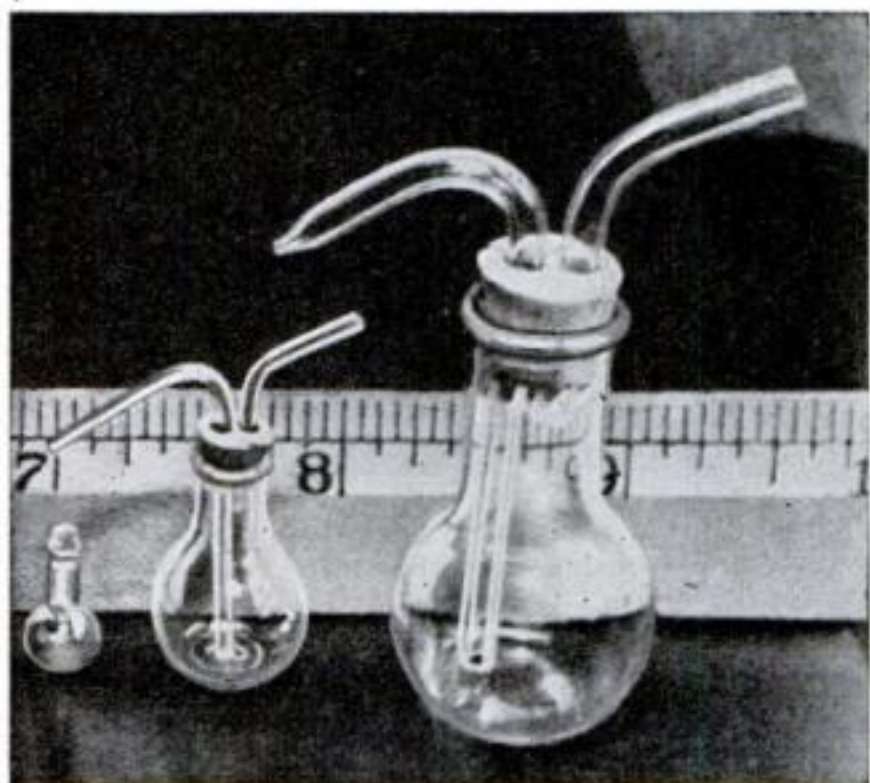


If a small center area is melted, tubing is easily pulled apart. Further heating will seal the ends.





# BEGINNER



These are all easy projects for the amateur glass blower. Albert C. Nuessle made the flasks at left, and W. Gilbert Spangler designed the objects above.

end will swell into a round bulb. Reheat the bulb and blow it again. Repeat until the bubble is about two and one-half times the original diameter of the tube. Once again heat the bottom, this time just to a dull red, and press it firmly down on a piece of asbestos, forming a base for the flask. Now rotate the bulb in a low flame for a few seconds to anneal it.

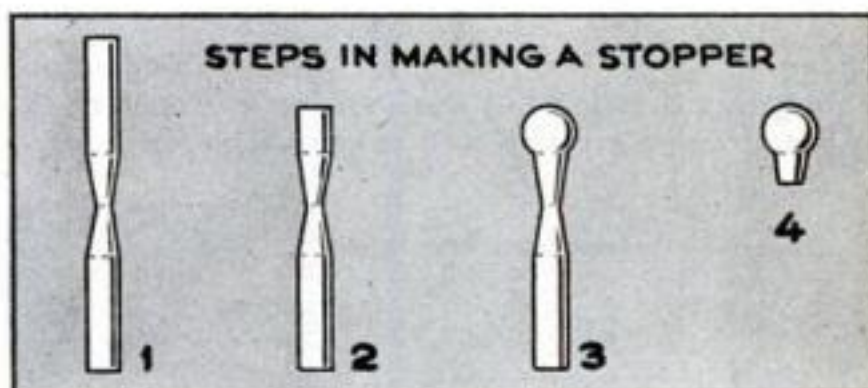
When the glass can be handled, cut off the excess stem with the file and slowly rotate the mouth in a low flame until it begins to soften. Then flare the neck by gently pressing a heated metal rod against the inside. Finally, anneal the entire flask.

Such flasks are easily made from tubing as small as 3 mm. in diameter. In the smaller sizes, the bulb generally will have to be held with pliers while the mouth is flared with a pointed knife. Equipped with a ground-glass stopper, made as shown at the right, the larger flasks are fine perfume bottles. Or it is an easy matter to convert one into a working model of a wash bottle.

For your first attempt at a wash bottle

begin with 10-mm. tubing and make a flask 22 to 25 mm. in diameter and 40 mm. high. Select a cork of proper size and cut it off so that the thickness about equals the width. Then heat the shank of a file or a piece of wire and burn two holes in the cork.

Now take some fine tubing  $2\frac{1}{2}$  to 3 mm. in diameter, soften a small area, and gently draw it out to form a nozzle. Cut it off at



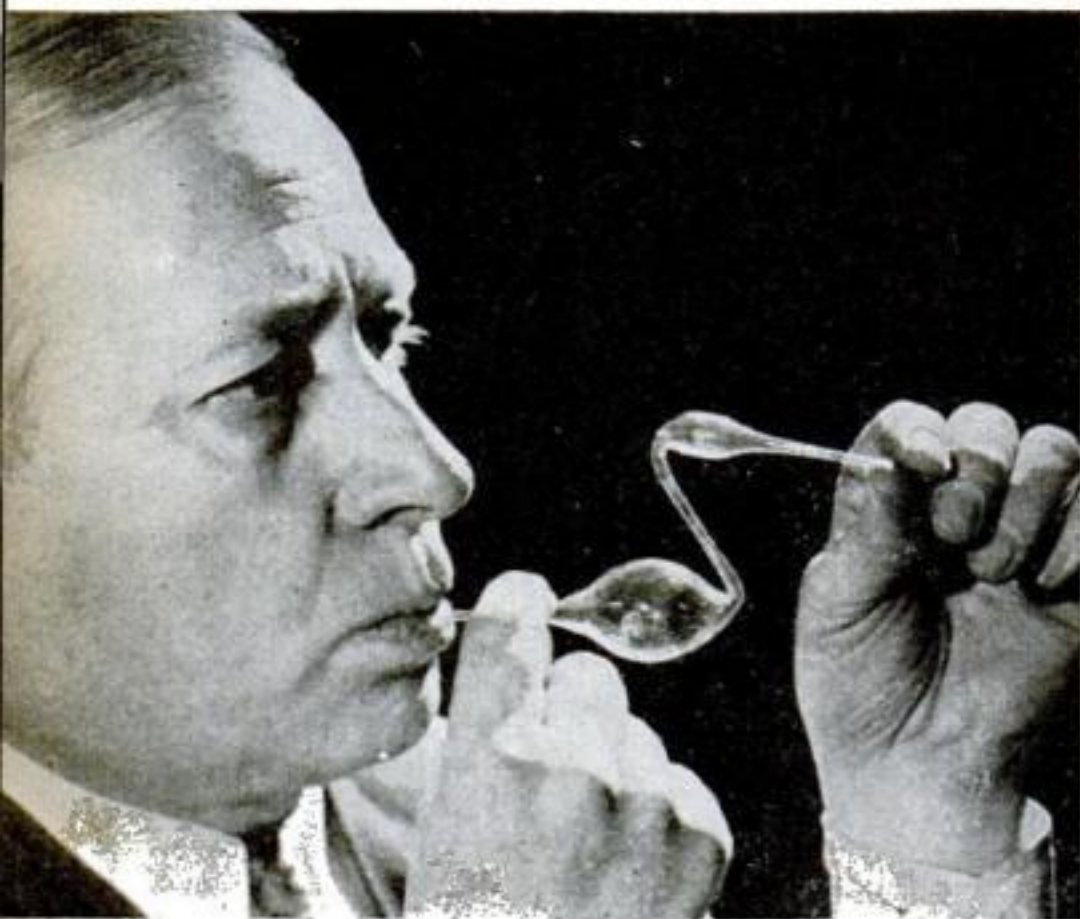
Begin with a glass rod a trifle too large to fit the flask. Narrow the center (1) by heating it and pulling the ends. Remove an end (2), melt the stub, and form a knob (3) with smooth-jawed pliers. Cut off the bottom (4), apply valve-grinding compound, and twist the stopper in the flask until it fits.

After the body of flask has been blown, heat the bottom and press on asbestos to form a flat base.

Heated until soft, the mouth of a flask is flared by pressing it gently with a metal or carbon rod.







After forming a graceful neck on the swan, remove any wrinkles from the glass by giving a puff into the tail, as shown at the left. An eye is attached by touching the molten end of a colored cocktail stirrer to a warmed side of the head and twisting the rest of the rod away.

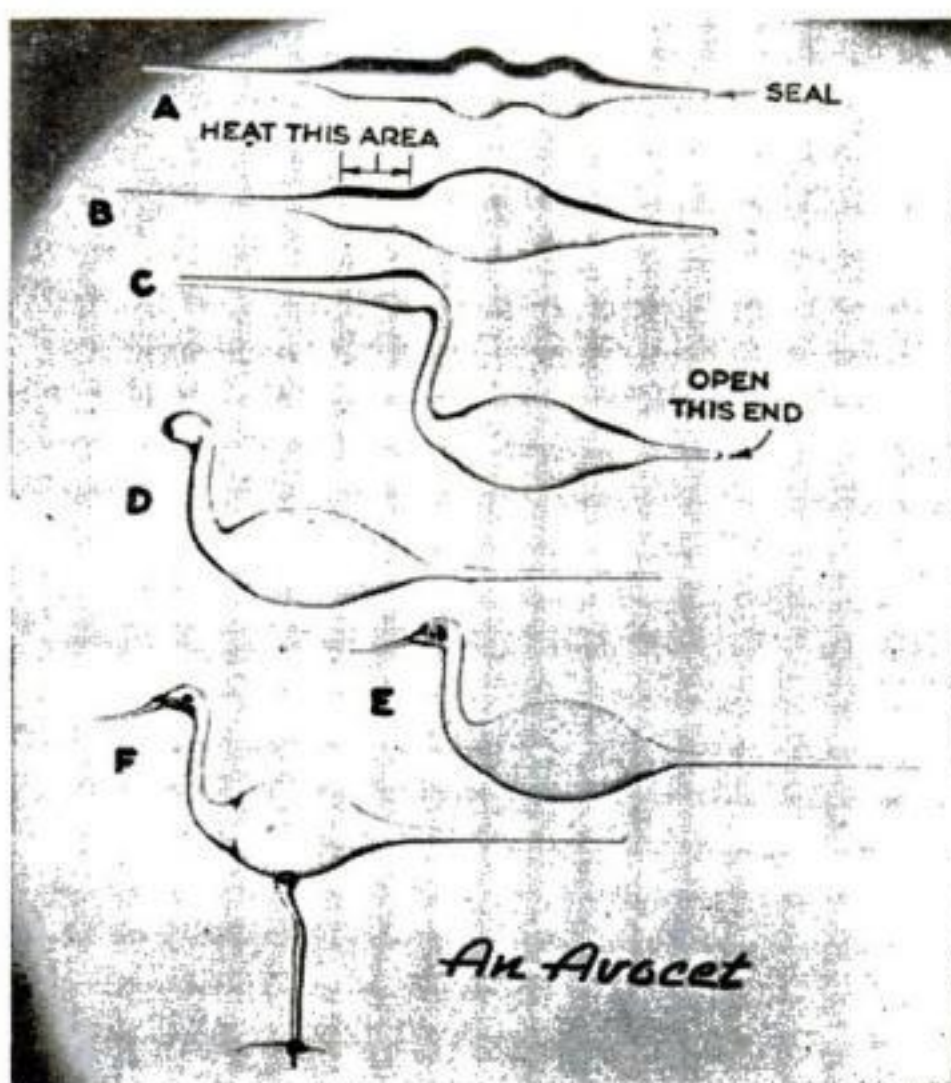
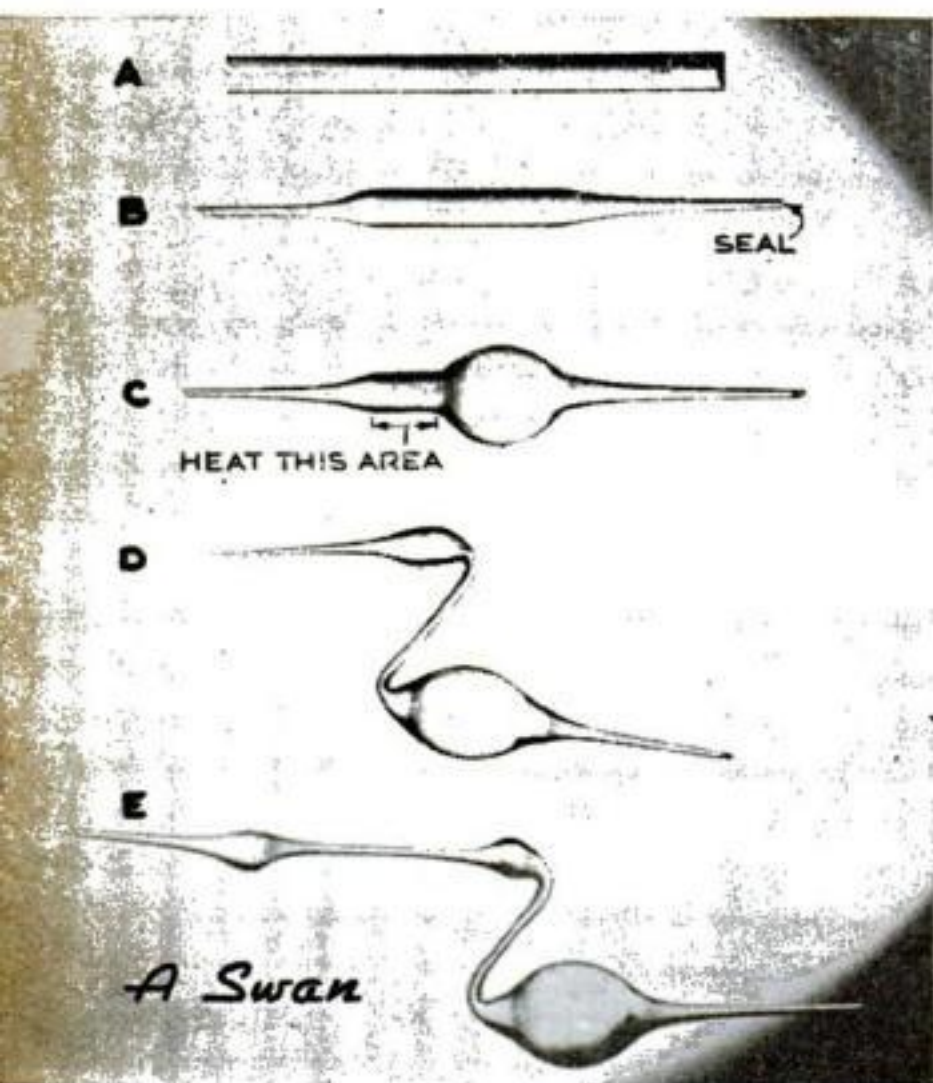
the narrowest point and polish the end in a low flame for a few seconds. Next, heat a larger area of the tube about 20 mm. from the tip and, when the glass softens, slowly bend the short end down to a 50-deg. angle. Cut the long end about 50 mm. from the bend. The short tube for the bottle is bent to an angle of approximately 130 deg. and cut off about 15 mm. on each side of the bend. Fire-polish all cut ends.

Two other interesting, but slightly more

difficult, projects are a swan barometer and an avocet, a long-legged bird. Either would decorate a shelf of unusual glassware.

Preliminary steps in blowing them are similar. If you have long tweezers, begin with a 10" piece of 10 mm. tubing, heating each end in succession and pulling it out with the tweezers to form handles. An easier procedure, however, is to heat a 36" piece of tubing about 15" from each end, pull it out by hand, and break off the waste end.

Successive stages in forming soft glass tubing into a swan or an avocet are given below. Begin each by heating and drawing out the ends, as in step B of the swan chart, to facilitate handling. Seal one end so the body can be blown into shape. Colored cocktail stirrers are used for the beak and legs of the avocet.



Photos by Tracy Diers



Your tube will now look like step *B* in the swan chart on page 200. Seal one end so that the body can be blown.

For the swan, next heat the main part of the tube about 1" from the point where it begins to taper. While the tube is heating push it together by pressure on both ends. This will thicken the glass. When soft, remove the tube from the flame and form the body (*C*) by blowing into the open end. Now open the sealed end.

Probably the most difficult operation is forming a graceful neck. Heat the area indicated in step *C* and quickly pull it out about 2", then back and upward (*D*). A puff into the opened end before the glass is cool will remove any wrinkles from the neck. After the head, pull out the beak (*E*), leaving the excess attached for the time being for easier handling. Flatten the bottom.

Eyes are formed from colored cocktail stirrers. Heat such a stirrer in the middle and pull it apart. Then melt one of the sharp ends and at the same time warm the side of the head. Touch the molten stirrer to the head and quickly pull it away with a twirling motion. The end will adhere. Polish it by holding briefly in the flame. After melting down and closing the tail, curl it up slightly with your iron rod.

Anneal the swan and snap off the beak.

Colored water forced through the hole in the beak turns the swan into a barometer. When water rises into the neck it is an indication of approaching rain.

You now are ready for the avocet. To make the elongated body, first blow two bulbs (*A*), then reheat both simultaneously, as well as the area between, and merge into one large bubble (*B*).

After opening the sealed end, heat the area indicated in step *B* and form the neck (*C*) as you did for the swan. However, don't push it as far toward the rear. Remember the quick puff into the tail to remove wrinkles from the neck. Then melt the head area and pull out the tubing until it comes to a point and breaks off. Heat the globule that remains and round out the head (*D*) by blowing into the opened tail.

Eyes, legs, and the bill are all formed from colored cocktail-stirring rods. For the bill, heat about  $\frac{1}{4}$ " of the end of a rod and at the same time warm the front of the head. When the rod is molten, press it against the head while blowing into the tail. Now heat the rod farther back and draw it out, producing the tapered bill (*E*). Attach legs (*F*) in the same way, fuse claws to the bottom, and cut off part of the tail.

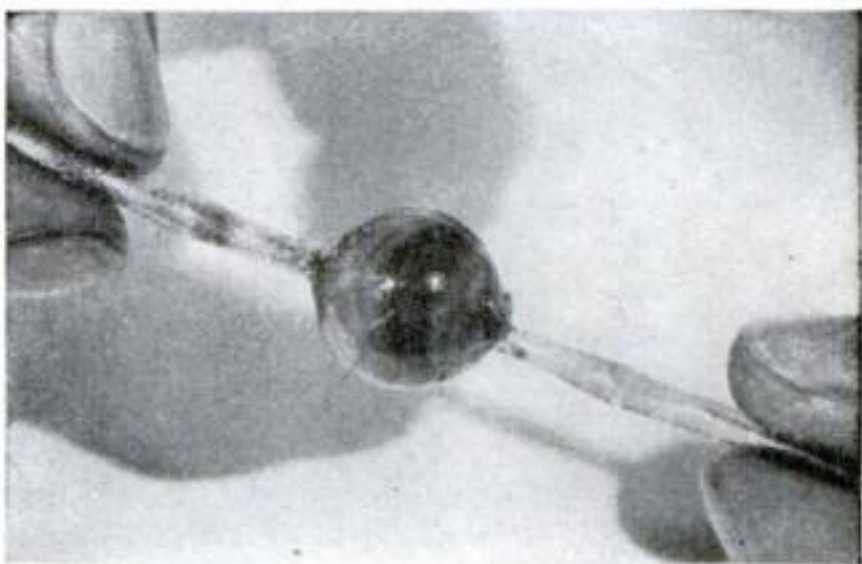
## Marbles and Stirring Rods Yield Variety of Glass Novelties

WITH a 10-cent bag of marbles and several cocktail-stirring rods it is possible to form a variety of glass novelties. When heated, the marbles and rods can be fused together and molded into any shape desired.

Use an old pair of pliers to hold each marble in a low gas flame for about three minutes. If this step is omitted the marble is apt to crack when subjected later to the hotter flame of a Bunsen burner.

To provide handles, fuse two stirring rods to opposite sides of the marble. This is accomplished by heating the edge of the marble in a Bunsen burner flame, simultaneously melting the end of the rod, and pressing the two firmly together. When joining two glass objects in this way, keep them constantly hot or they may crack.

Next heat the marble in the center. After it has become soft you will be able to push or pull it into any shape by means of the handles. Personal ingenuity must now take over to decide what your finished novelty will resemble. There are many possibilities—dogs, cats, rabbits, birds, fish, or what you will. Various parts can be formed from marbles of different colors and finally fused together. A scratch with a triangular file will enable you to break a piece at any point.—W. GILBERT SPANGLER.

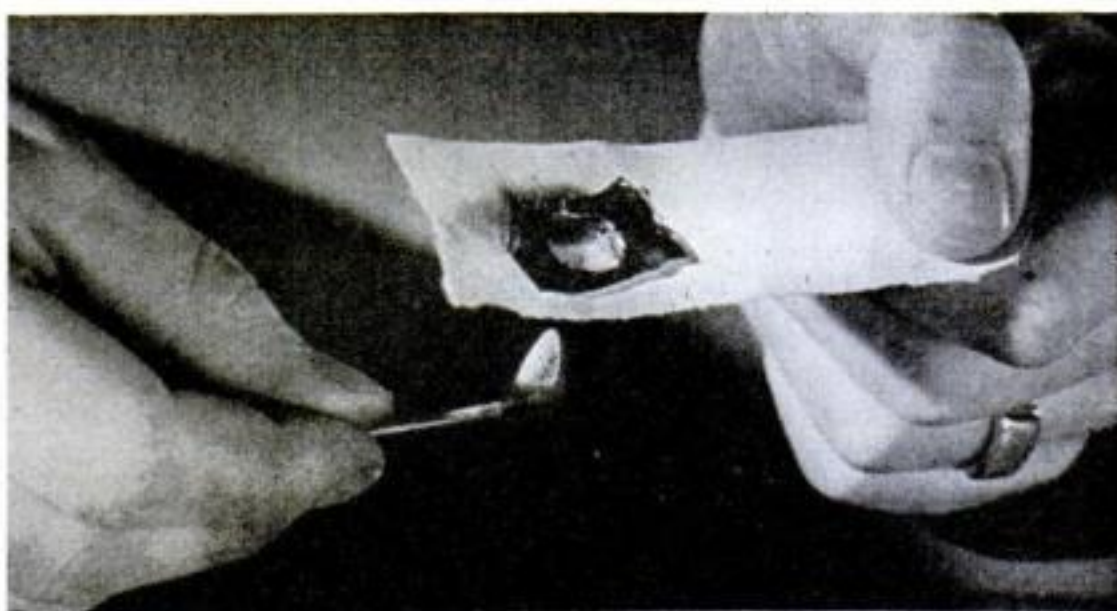


Glass rods fused to the sides serve as handles for shaping the above marble into a novelty. Softened in a flame, the marble below takes form as a fish.

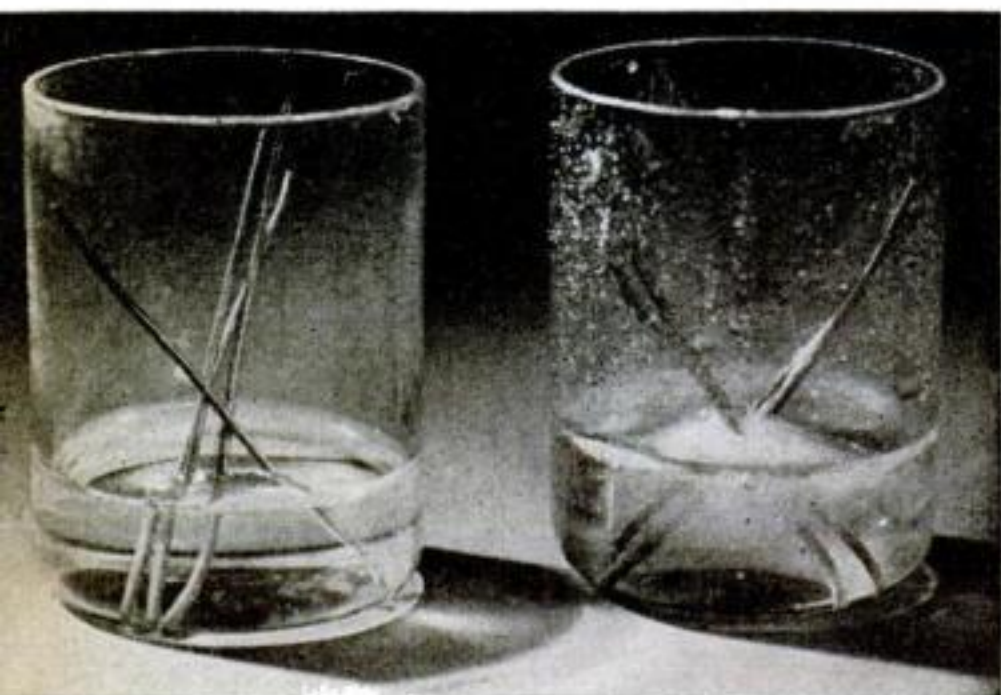




# HOME EXPERIMENTS REVEAL STRANGE

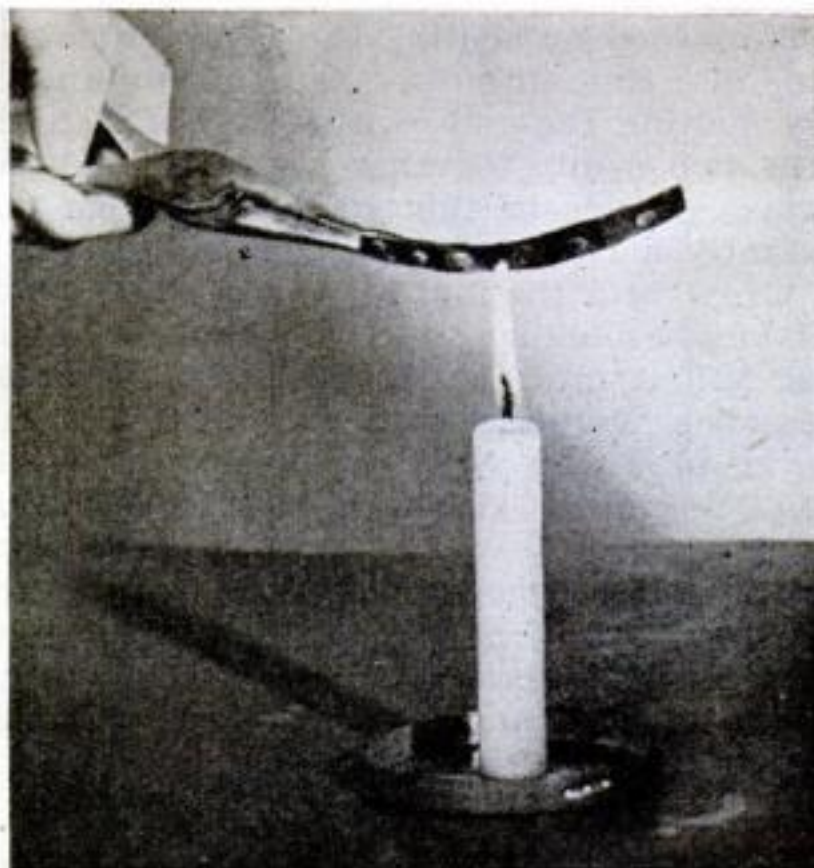


**TIN IS SO BRITTLE** at 200 deg. C., only 32 deg. below its melting point, that it turns to powder when pounded. You can demonstrate this, as at the left, by heating a flatiron hot enough so that a piece of tin foil melts when placed on its upturned face, then striking the metal occasionally with a hammer as it cools and solidifies. At one point, the tin will shatter into a powder when struck. Another interesting characteristic of tin is that it can be melted on paper without igniting the latter, as shown above. Smooth out a piece of foil on thin paper and hold a match under it, without touching the paper, until the metal liquifies. The foil conducts heat from the paper so rapidly that it does not burn.



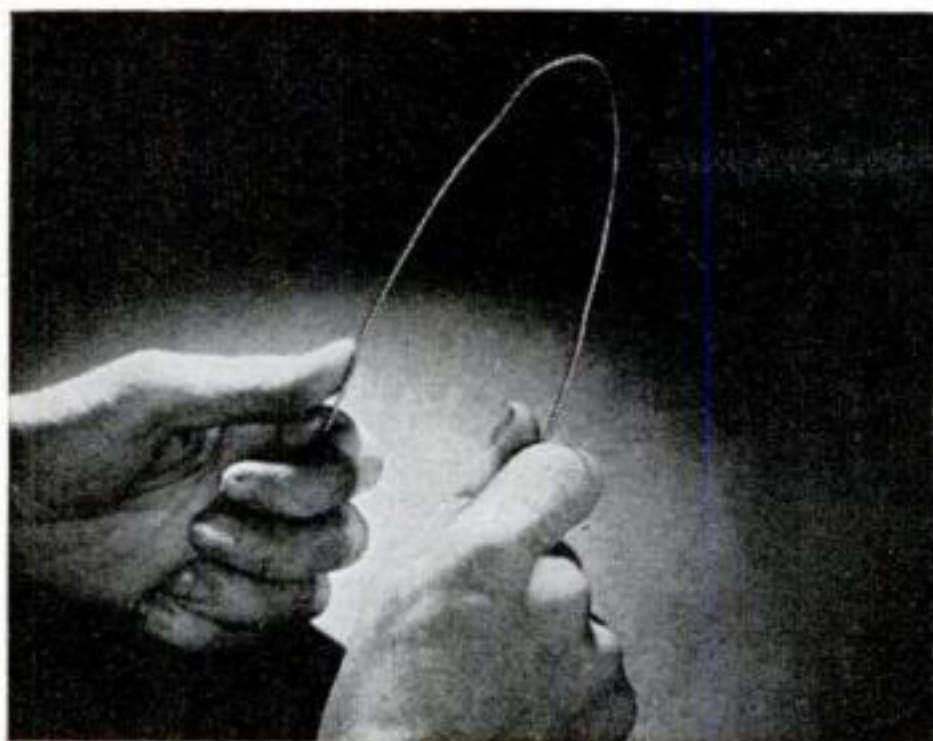
**IRON DISAPPEARS** quickly when placed in dilute sulphuric acid, but if dropped into the concentrated acid, as shown at the left above, virtually nothing happens. This is explained by the fact that the concentrated acid acts as an oxidizing agent, quickly coating the iron with an oxide that resists further reaction, while the diluted acid reacts vigorously, liberating hydrogen and forming iron sulphate in solution. Because of this property, the concentrated acid can be transported in steel tank cars, and cast iron or steel vessels are used in the final stages of its manufacture.

**METALS EXPAND** unequally. This may be shown by cutting a strip from a tin can (this is really tin-coated iron or steel) and riveting it face to face to a similar strip cut from copper, brass, zinc, or aluminum. When grasped with tongs and held in a candle flame as shown below, this compound strip gradually curls inward toward the side faced with the tin plate. Why? Because the thermal expansion of iron or steel is less than that of the other metals. The second metal, expanding more, forces the bar to bend.

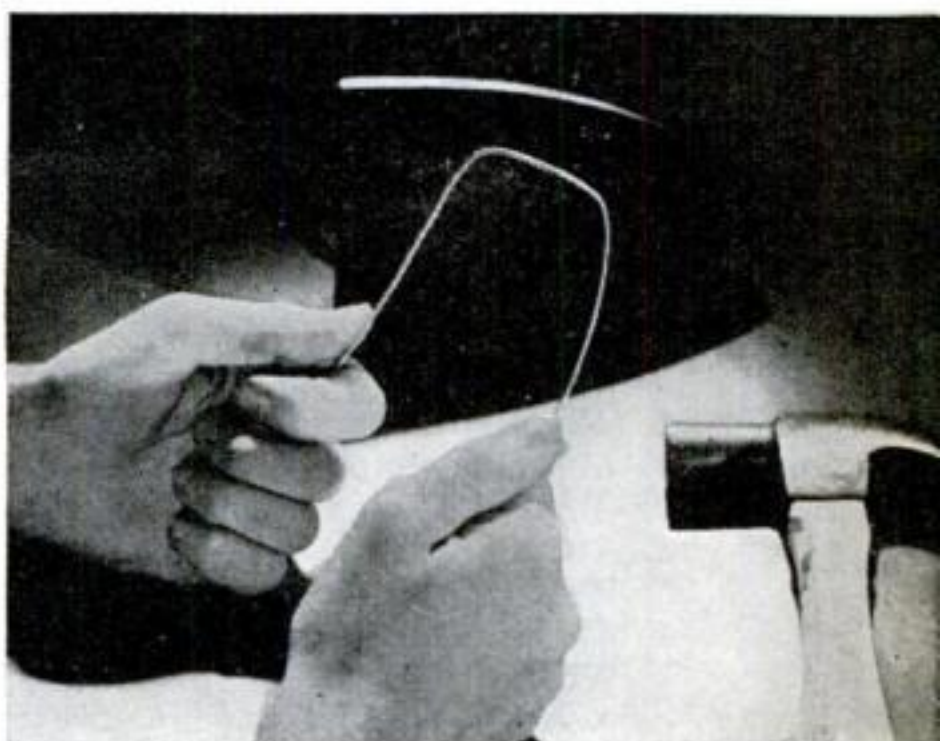




## FACTS ABOUT METALS



**COPPER HARDENS** when it is hammered. It might seem that this soft metal would become softer still if subjected to pressure, but such is not the case—as this simple experiment will show. First, anneal a piece of stout copper wire by heating to redness and letting it cool slowly. If you now grasp the ends and pull them together, the wire will bend sharply in the middle. There is

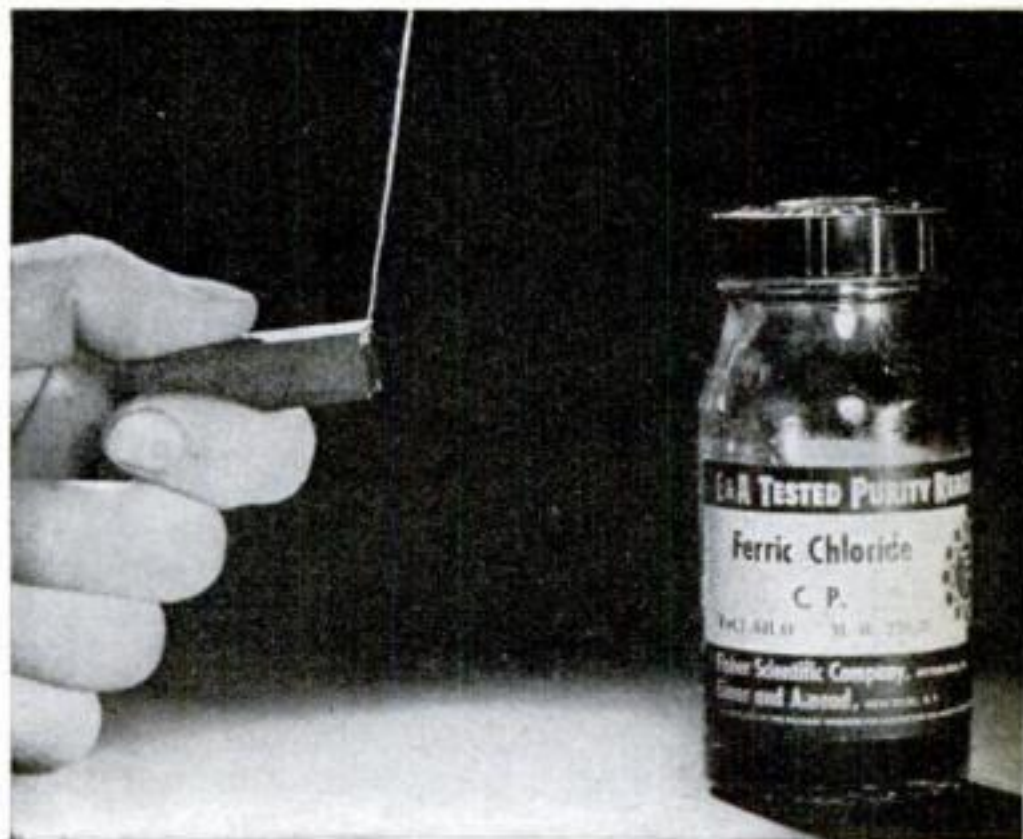


an entirely different result, however, if the wire is straightened and several inches of the center hammered on a flatiron or an anvil. This time the wire doesn't bend in the middle—but at the two ends of the hammered portion. This part has now become too hard and stiff to bend with ease. When copper must be hardened commercially it is subjected both to hammering and rolling.



**PARADOXICAL TOP.** Made by thrusting a pointed stick or pencil through a hole in the center of a tin can cover, the top at the left doesn't always react in the way you might expect when a magnet is placed near it. Actually tin-plated iron or steel rather than tin, the cover is attracted by the magnet while at rest. But set it to spinning—and it is sharply repelled. This repulsion is caused by a countermagnetic force produced by eddy currents set up in the top.

**MAGNETIC LIQUID.** Everyone is familiar with the way magnets attract iron, steel, and, to a lesser degree, nickel and a few other metals. But few realize that certain liquids also react the same way. You can easily prove that they do by using a strong solution of iron chloride. Ordinarily crystalline, this chemical has a tendency to deliquesce—melt away in water drawn from the air. Allow a small crystal to remain in the open until this happens. Then tie a tiny loop on the end of a piece of thread and use it to pick up the drop of concentrated iron chloride solution. If you now hold one of the poles of a strong bar or horseshoe magnet close to this drop as it dangles at the end of the thread, you will find that a prompt and definite attraction occurs.







## CHEMISTRY QUIZ

HERE is chemistry in rhyme—a description of ten ordinary substances by their more or less common names. Their chemical names are given in the opposite column, but not in the right order. Can you place the correct number beside each chemical name?

1. What is the chemical name for rust?
2. And how would you designate marble dust?
3. What once was used for flashlight powder?
4. And what is the salt for seasoning chowder?
5. What is potash to the chemist true?
6. And what is known as Prussian blue?
7. What are diamonds, precious jewels?
8. And what ore is known as the gold of fools?
9. Quicklime is known by what other name?
10. Now find carborundum. So end this game!

- Magnesium.
- Sodium chloride.
- Ferric oxide.
- Calcium carbonate.
- Iron sulphide.
- Calcium oxide.
- Silicon carbide.
- Potassium carbonate.
- Ferric ferrocyanide.
- Carbon.

If your score is nine or ten,  
You rank among the wisest men;  
And if you rate a seven or eight,  
You're pretty good—in fact you're great.  
Should five or six be your best guess,  
Be glad you made not even less!

### ANSWERS

10. Silicon carbide.
9. Calcium oxide.
8. Iron sulphide.
7. Carbon.
6. Ferric ferrocyanide.

1. Ferric Oxide.
2. Calcium carbonate.
3. Magnesium.
4. Sodium chloride.
5. Potassium carbonate.

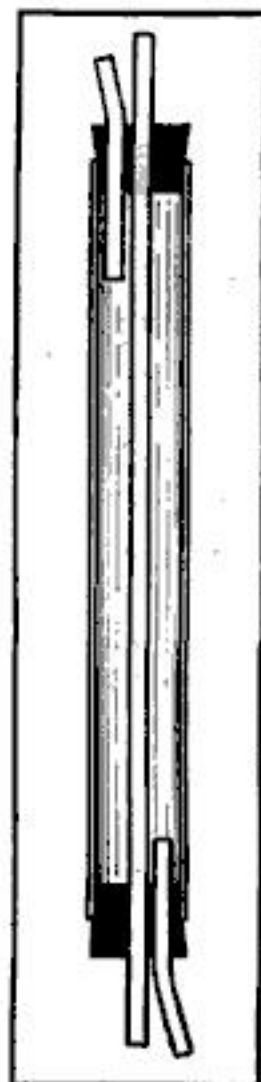


### ← Home-Lab Distilling Flask

IF YOU have no long-neck Kjeldahl flask for distillation purposes, you can improvise one from an ordinary short-neck flask, a thistle tube, some one-hole rubber stoppers, and a length of 5 or 6-mm. glass tubing. Insert the tubing in a rubber stopper that closes the thistle tube, bend it to the shape shown at left, and set the tube in the flask as indicated.—DONALD R. RANDELL.

### Fluorescent-Tube Condenser →

SATISFACTORY condensers can be made from burned-out fluorescent-light tubes. Cut the ends off and smooth them in a Bunsen flame, and then stopper both ends with two-hole cork or rubber stoppers in which glass tubing is inserted as shown at right. The coolant is flowed through one of the short tubes and out of the other, while the gas or vapor being condensed is flowed slowly through the long tube into a collecting receptacle.—MORRIS LIGHTFOOT, JR.





# Fortunes in Air-Mail Stamps *(Continued from page 131)*

When the company finally folded up, pilot Morgan brought a few unused stamps to New York and sold them to the late John N. Luff, of the Scott Stamp & Coin Company. The stamps were quite unknown, and the Scott people had a lot of trouble disposing of them at \$400 each. Later, only two were left in existence, and if you can buy one of them today for less than \$15,000 you will be lucky. This is the third item illustrated on page 129. It is a regular 10-centavo dark-blue stamp overprinted in black.

The three most valuable "inverts" are also shown on page 129. At the top is the 24-cent United States 1918 issue. Directly under it is the 10-centavo vermillion-and-black Bolivian stamp of 1924. Perkins, Bacon & Co., Ltd., of London, printed 225,000 such stamps, in sheets of 50. One of these sheets was printed with the center design inverted. A regular stamp is worth a dime; the "invert" is worth \$2,000.

Last year another instance of inverted center design was discovered, in the same 1924 Bolivian issue. This is the fourth stamp on the page. This stamp, two bolivianos in denomination, of which only 20,000 were printed, is black-brown with a black insert. A single sheet of inverted inserts passed unnoticed for 20 years, and only a few examples have been found. Its present value is \$3,000, which may be \$1,000 too much—or \$5,000 too little. It will depend on how many of these stamps are still in existence after the collectors and dealers check through their stocks.

The stamp centered at the end of the same page was issued in Mexico in 1928. The printer was short of inks, and printed a big batch of the 25-cent stamps in brown-carmine and brown (these are worth twenty cents), another batch almost as large in dark green and gray-brown (these are worth a quarter), and a small number in brown-carmine and slate green. The brown-carmine and slate-green stamp is worth \$2,800 today; it may easily be worth more.

Last on the page of rarities is the "Red Honduras," overprinted under the same circumstances and at the same time as the famous "Black Honduras." This is the five-centavo regular blue stamp, overprinted in red. Only seven such stamps were issued with red overprint, and each of them is worth \$10,000.

Newfoundland has given us three valuable stamps, one of which is shown sixth on the page. In 1933, 8,000 75-cent bister (dark brown) stamps were overprinted for Balbo's flight. These are now priced at \$27.50 each.

A single sheet of eight 10-cent yellow stamps—almost the same color—was similarly overprinted, and each stamp is now worth \$6,000.

Another Newfoundland stamp, of great historical value, is the fifth item in the layout. This is the famous "Hawker," of which 200 copies were overprinted for the first transatlantic air post. This was on the attempted flight from Newfoundland to England by H. G. Hawker and K. M. Grieve, who took off from Newfoundland on May 18, 1919, but were forced down at sea 1,100 miles out. The flyers and mail were rescued and taken to Scotland. Only 200 copies of the three-cent red-brown Newfoundland stamp were overprinted by Postmaster J. A. Robinson; 95 stamps were used for postage, 18 defective stamps were destroyed, one was given to King George V, one to the Governor of Newfoundland, one to the Aviation Club, six to the aviators, two to the Castle Museum; and 76 were kept by collectors. The few unused stamps still in existence are worth \$2,250 each.

At the lower left-hand corner of the same page is shown one of the most frequently faked stamps: China's Sinkiang 15-cent deep blue, overprinted in red. Used stamps of this denomination are fairly common, and seldom fetch more than \$100 each. The genuine unused stamps are extremely rare; they fetch \$2,750 apiece.

The seventh stamp of the lot is the famous Newfoundland De Pinedo stamp of 1927. It was issued on May 21 of that year for the attempted flight of Commander Francesco De Pinedo, who was forced down at sea in his seaplane *Santa Maria II*, found, and towed to the Azores. He finally completed his flight to Rome on June 1, 1927. Only 300 stamps were overprinted, and most of them were used on letters. Three years after his flight, unused stamps of this issue could still be bought for around \$100 apiece; a fair price today is \$3,750.

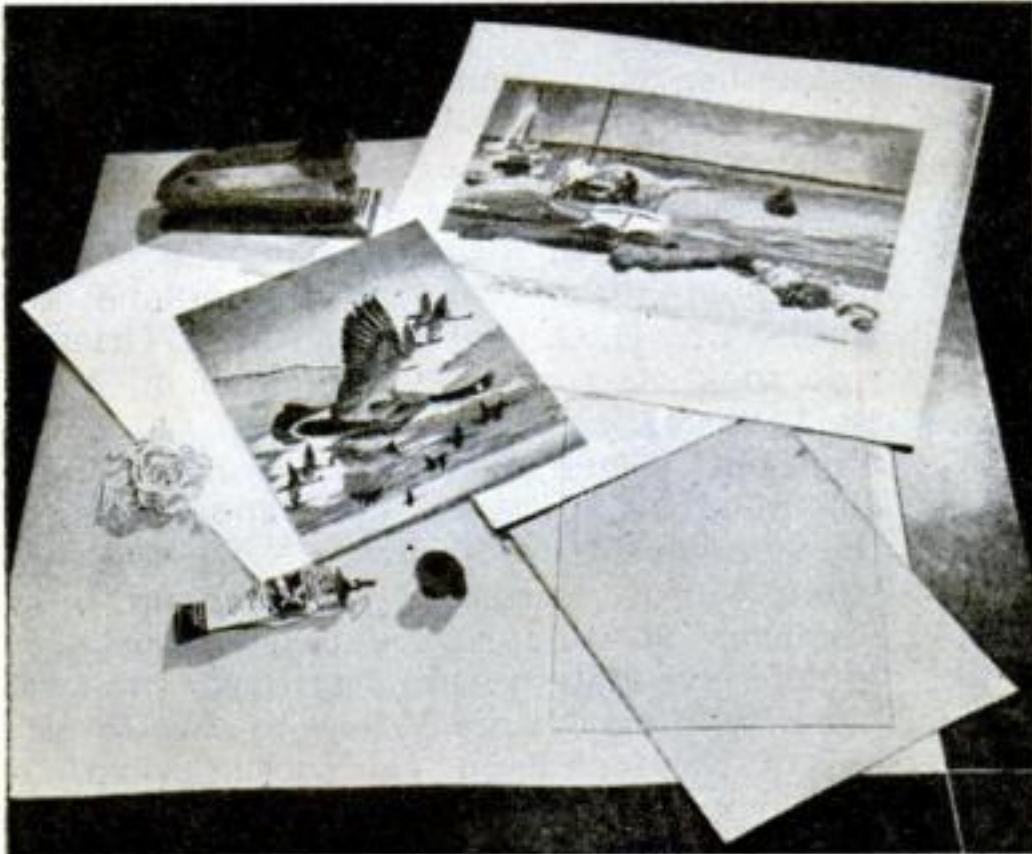
Indeed, there are fortunes in air-mail stamps!

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# LOW-COST FRAMING WITH PASSE PARTOUT



This is what you use: glass, cardboard, passe partout, paste or glue, cord, possibly a stapler, and the picture and mat.

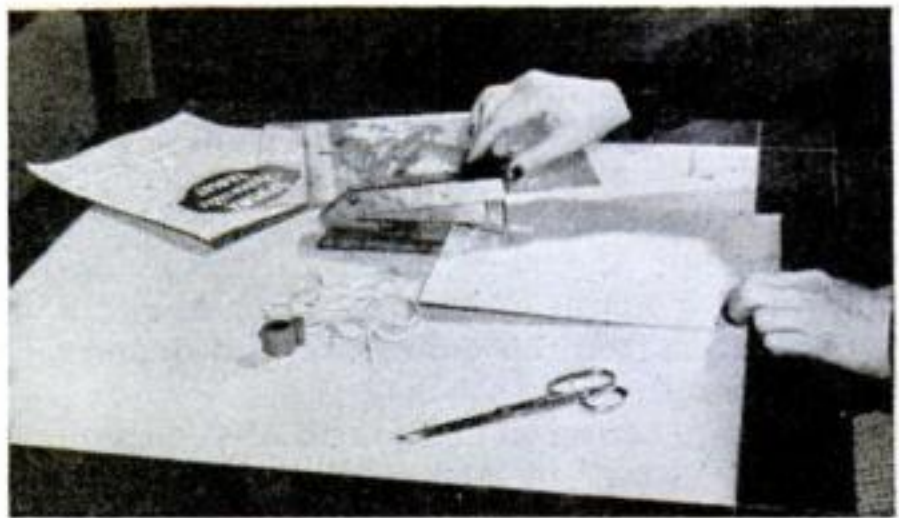
**P**ASSE PARTOUT is an effective and economical way of framing photographs, prints, and pictures from magazines. Its cost is so low that it allows taking advantage of the low-price sale of fine prints offered at many of the country's museums, something that may be just what's needed for filling a bare wall spot or completing a modern room.

The passe-partout tape used is gummed on one side for quick application. It is heavy enough to hold a large glass, picture, and backing. A variety of colors is available at stationery and art-supply stores.

Have the glass, the picture to be framed or its mat, and the cardboard backing all exactly the same size so the passe partout can



**1** Obtain glass of the exact size of the picture mat and cut a backing of cardboard to fit it. All must be the same size for a satisfactory job.



**2** Before going further, attach cord to the back for hanging the picture. Here it is done with three staples at each end. Knots prevent slipping.

**5** Cut strips of passe partout  $\frac{1}{2}$ " longer than the length and width of the glass, moisten the gummed side, and apply one strip at a time.

**6** Press half the width of the tape to the glass and turn the other under. The  $\frac{1}{4}$ " overlap at each end allows for folding to make neat corners.





make good contact and will hold firmly. Most museum prints and the like come with a border, but photographs and some other prints may require mounting on a mat for an effective showing. Paste or glue the picture to the mat only along a line at the top to prevent puckering.

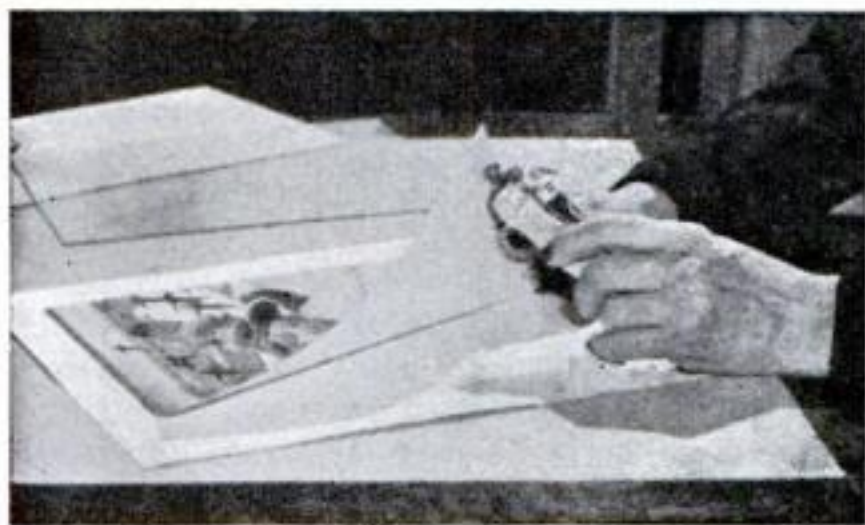
Attach a cord to the cardboard backing before starting to frame the picture. This may be done with a stapling tool, using three staples for each end of the cord, or by threading the cord through holes and knotting.

Sandwich the picture between the glass and backing. Cut strips of passe partout  $\frac{1}{2}$ " or so longer than the length and width to allow for folding over at the ends, moisten the back, and stick the strips one at a time first to the glass and then, folded under, to the cardboard backing.

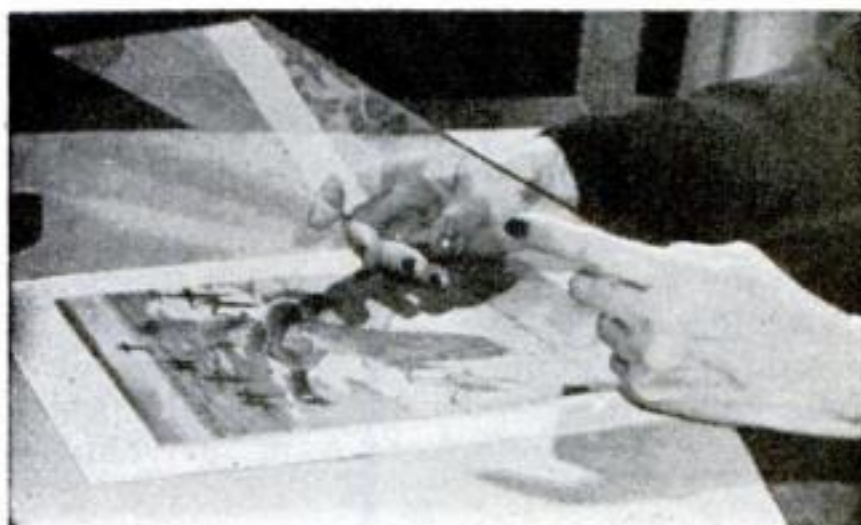
—TOM MCCA HILL.



Passe-partout mountings will combine with many decorative schemes.

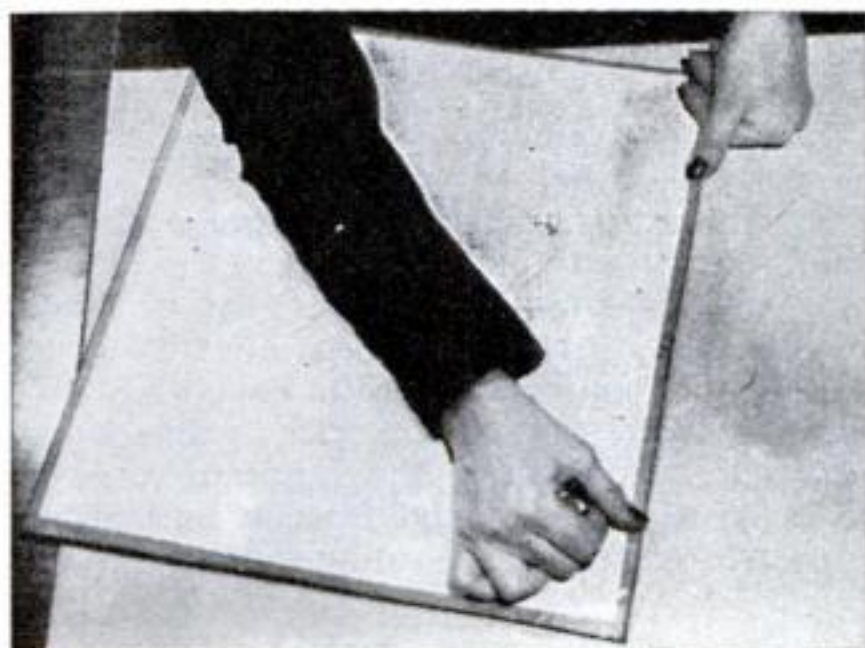


**3** If the picture has no border, provide one by mounting it on a mat of heavy white paper. Paste it only at the top so it will not wrinkle.



**4** You are then ready to sandwich the picture between the glass and backing. Be sure the backing is arranged so the cord is near the top.

**7** As each length of tape is turned under, press it firmly to the backing to make it secure. At right, three museum prints framed on the wall.





# Saving Flyers in the Arctic

(Continued from page 127)

I flew a search mission in Newfoundland based on such a tip turned in by a "Newfie," as the Yanks call a native. The lost ship had last been reported over the field three weeks previously in zero-zero weather and had then just disappeared completely. The ASR crew of the field was still looking for it in spite of heavy snows that had fallen in the meantime. First we flew a grid pattern over the area where the "Newfie" reported that he had found what he believed to be pieces of a plane; then we really went down on the deck and took a closer look for anything that might indicate the crash. Two days later, the plane was found deep under the snow.

Finding a crashed plane is one of the toughest jobs in the world, particularly in the northern wilds. Rarely does the ship finally come to a stop still resembling an aircraft. In summer, it most often looks like bits of metal sawdust sprinkled on a green carpet; on the deep winter snows, it is a dark smear speckled with bits of tin foil. Frequent heavy snows make the search doubly hard, and years may pass before the wreck is located if it is in a particularly isolated area.

Once the wreck is spotted from the air, the searching plane radios directions to the ground parties proceeding from the nearest base by dog sled, snow tractor, old reliable Army mule, Weasel, or "shank's mare." Sometimes the rescuers are able to drop mechanized equipment for the salvage or repair and take-off of flyable planes and thus make a double rescue of personnel and plane.

Take, for example, the case of veteran ATC pilot L. J. ("Chuck") O'Conner. In February 1943, he was flying a Consolidated C-87 (a transport version of the Liberator bomber) when he was forced down on the ice of an unknown and nameless lake in northern Canada. The plane was undamaged but unable to get off again. The temperature was down to 70 below zero. Radio contact was made the following day, but, owing to the severe cold, the octant used to establish the location was two and a half degrees off, with the result that the plane was not found for a week.

Once located, the crew were furnished with everything imaginable to make for arctic comfort—well, all right then, existence. O'Conner and his crew served as a sort of involuntary testing laboratory for all sorts of arctic equipment under development. For 32 days they lived at the scene of the landing while ways and means were

tried out to prepare a runway for the plane so that it might be flown out.

A snowplow on a Ford tractor was dropped to them, along with other items of runway-building equipment, but the snow was too deep for them to move. Holes were chopped in the ice, and the lake water was pumped up and sprayed on the snow to form a frozen runway. This did not work. The water soaked into the snow and refused to freeze at all, merely making the snow mushy and even harder to handle. Eventually, however, runways were cleared, and the plane was flown out. The scene of this rescue is no longer nameless, for the Canadians have since dubbed it Lac O'Conner.

Much of the rescue work is possible through the use of sled dogs and their equipment. Nearly all of the 100 downed flyers brought out of the wastes since the inception of the ASR units in 1943 have owed their rescue in part to the use of dogs, many of them born in the service.

The dogs chosen for the work are picked for their strength, speed, endurance, and good nature. Many are trained at the War Dog Reception Center in Montana, while others have been trained at Presque Isle, Me., where nearly 100 dogs and their attending personnel are stationed.

In all, about 29 dog teams are spread over the U. S. Army bases in the North. Besides the huskies used with sleds, Saint Bernards are used as individual pack dogs or to pull pulkas, which are like snow shovels without handles. These small plywood, boatlike affairs can carry either several hundred pounds of cargo or an injured person through the underbrush.

Working in close co-operation with the Arctic Search and Rescue Squadron are the crash boats of the Coast Guard and other service units, while inland, the RCAF, the Forest Services, and the State Police and ski patrols co-ordinate their facilities with those of the service. Natives, hunters, traders, and trappers also pitch in to help the rescue gang bring 'em back alive to fly again.

The splendid record of the Arctic Search and Rescue Squadron will serve not only as a tribute to American courage and ingenuity but as a foundation for all similar organizations for the greater safety and peace of mind of the millions of air travelers of the future across the arctic routes. Such travelers will remember with pride and gratitude the valiant and vigilant crews of the Arctic Search and Rescue Squadron of the Air Transport Command of the AAF.



# So you'll be safer

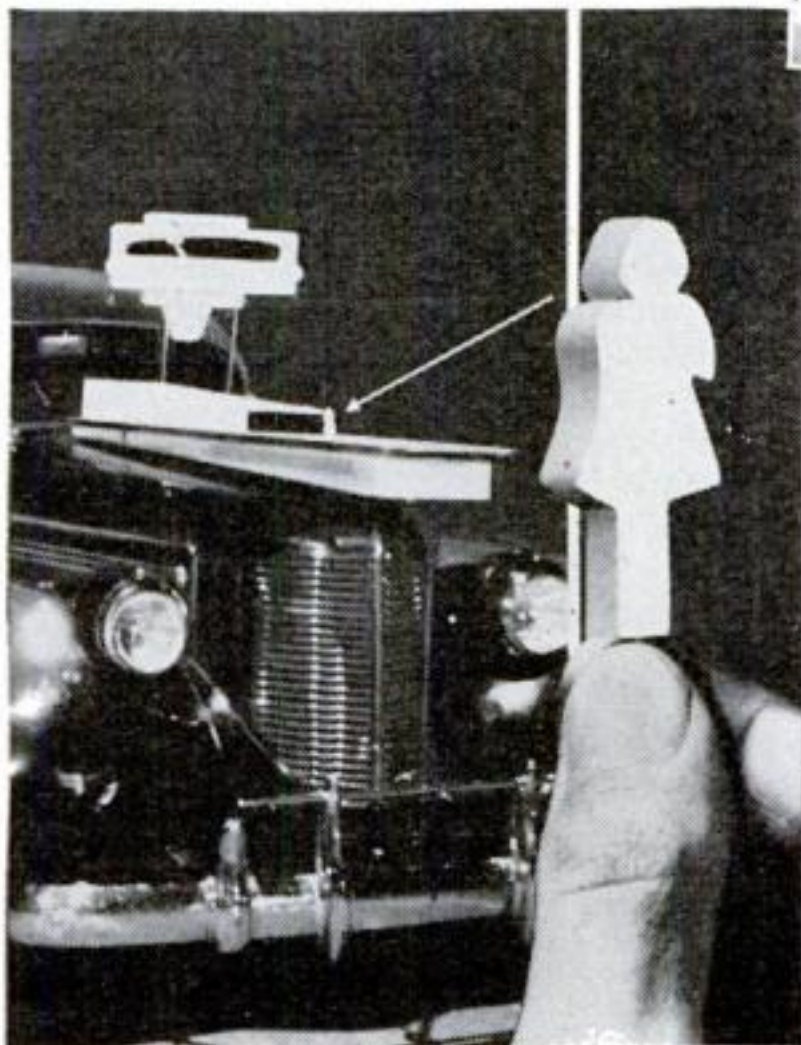


Radar, for all its wonders, is only one of the fields in which General Electric science has worked for your protection. Among many other G-E achievements are better street lighting, which reduced night traffic accidents in one city 93 per cent in ten months . . . powerful x-ray units used by manufacturers to detect dangerous flaws in metal . . . a way to help prevent disastrous fires on farms by means of a new hay-drying system.

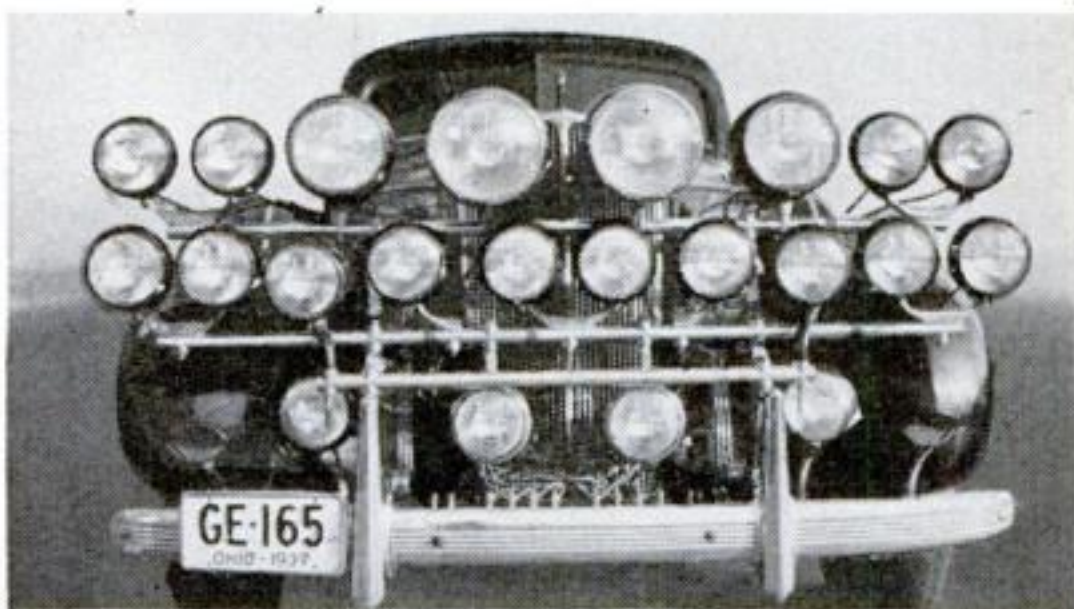
Working on developments such as these, G-E engineers and research scientists are helping to make life safer for everybody. *General Electric Company, Schenectady, N. Y.*



**Radar prevents collision.** This actual photograph taken on the bridge of the "American Mariner," U.S. Maritime Service Training Ship, shows General Electric's new peacetime Radar Electronic Navigator helping plot a safe course. The officer is looking at the G-E Navigator's radar screen which shows him the position of the ship and the objects around it. On ships or planes, in fog or darkness, radar will warn pilots of unseen hazards.



**2-inch doll saves lives.** Central character of an ingenious apparatus to test street lighting is a tiny doll that represents the average pedestrian as seen at a distance. The complicated device measures visibility and glare. It was devised by General Electric engineers to help make streets and highways safer for night driving.



**Bug-eyed auto** was the car used in development of G-E Sealed Beam headlights adopted by the automobile industry. The Sealed Beam headlamps give more and safer light. Tests show that the average G-E Sealed Beam lamp gives 99 per cent as much light near the end of its life as it did when brand new. About 45 lamps of Sealed Beam type have been developed by General Electric for the Army and Navy.

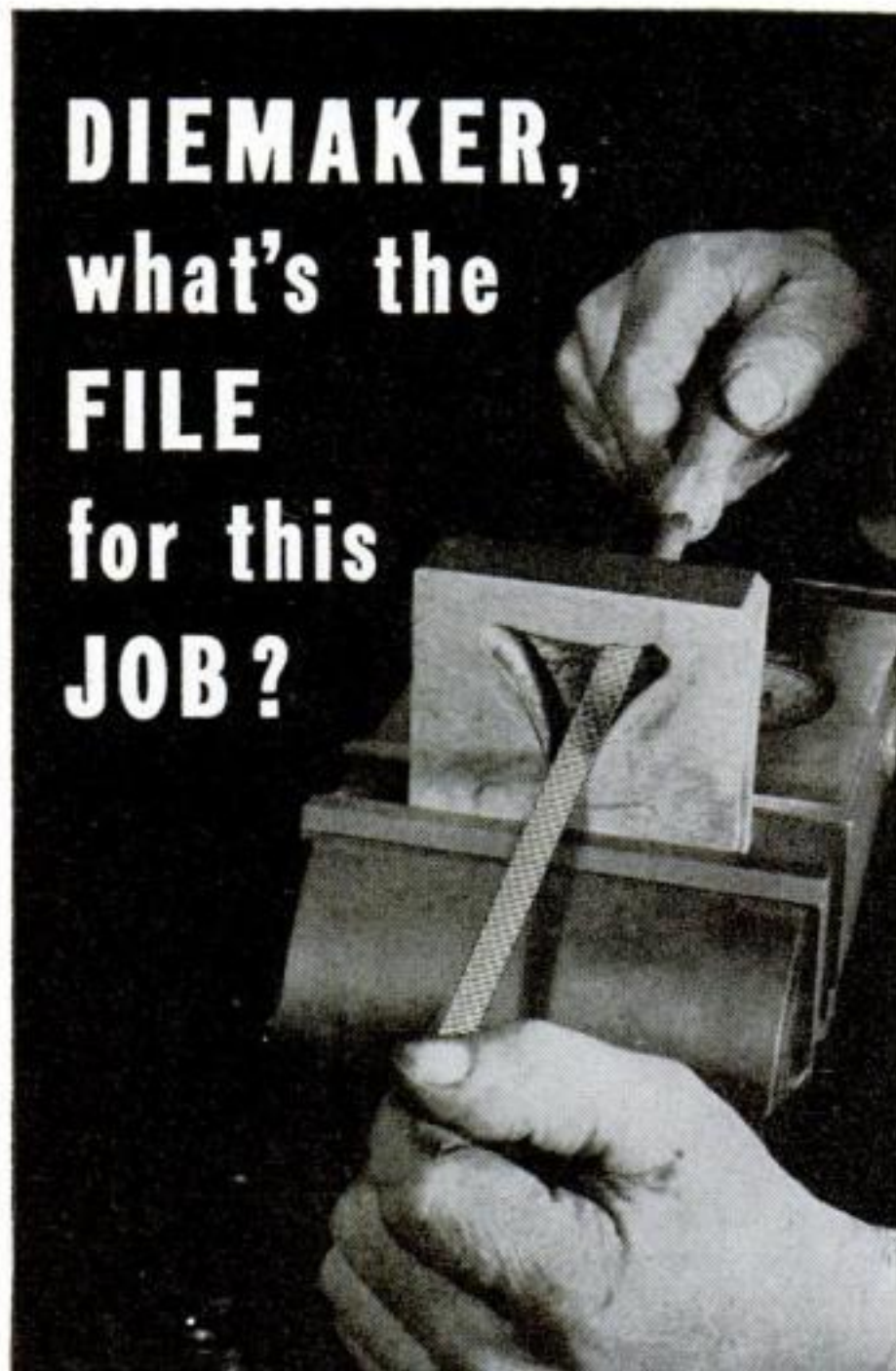
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# GENERAL ELECTRIC



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## What's Behind Atomic Power?

(Continued from page 73)

prying eyes, a ball-shaped mass of graphite blocks rose, toward the end of 1942. Supported by wooden framework, the sphere contained six tons of precious uranium metal. The blocks were embedded in a "lattice" pattern, occupying points corresponding to the corners of a cube, which had proved more favorable than mixing uranium with carbon at random.

Safety precautions surrounded this venture into the unknown. Through slots piercing the strange reaction chamber, strips of cadmium or of boron steel, both absorbers of neutrons, could be inserted by hand or by remote electric-motor control to check the hoped-for reaction. They were kept in place during construction of the pile, for which its designers had figured out a minimum or "critical" size at which it should begin to work. As the pile took shape, one of these control strips was removed from time to time so that radiation meters could show whether the pile was in action.


On December 2, 1942, with the sphere only three fourths completed, the telltale meters signaled a history-making message. The first self-sustaining chain reaction ever initiated by human beings was operating. That day, the exultant experimenters held down the energy output of the pile to half a watt, since they still had to learn how far they could safely unleash this new force. Later they ran the pile up to 200 watts, the limit at which its penetrating radiations would not endanger persons in the university's building and on the sidewalks.

At the end of 1942, the total quantity of pure plutonium salts in the country amounted to about 500 micrograms—less than enough to make the head of a pin! But workers in the young science of microchemistry consider as little as a single microgram enough for weighing experiments, titrations, and solubility tests. They took plutonium in hand and reported its chemical properties as completely and accurately as if they had worked on pounds of it. This information would prove invaluable, for instance, in separating plutonium from other ingredients and products of the chain reaction in the pile.

On paper, again, everything looked rosy, but there was a catch. At an estimate so rough as to give away no valuable secrets, it would take the experimental pile at the University of Chicago no less than 70,000 years to produce enough plutonium for a single bomb. In contrast to the 200-watt capacity of the Chicago pile, a plant or

(Continued on page 214)





*"Oh brother, does he need  
new piston rings!"*

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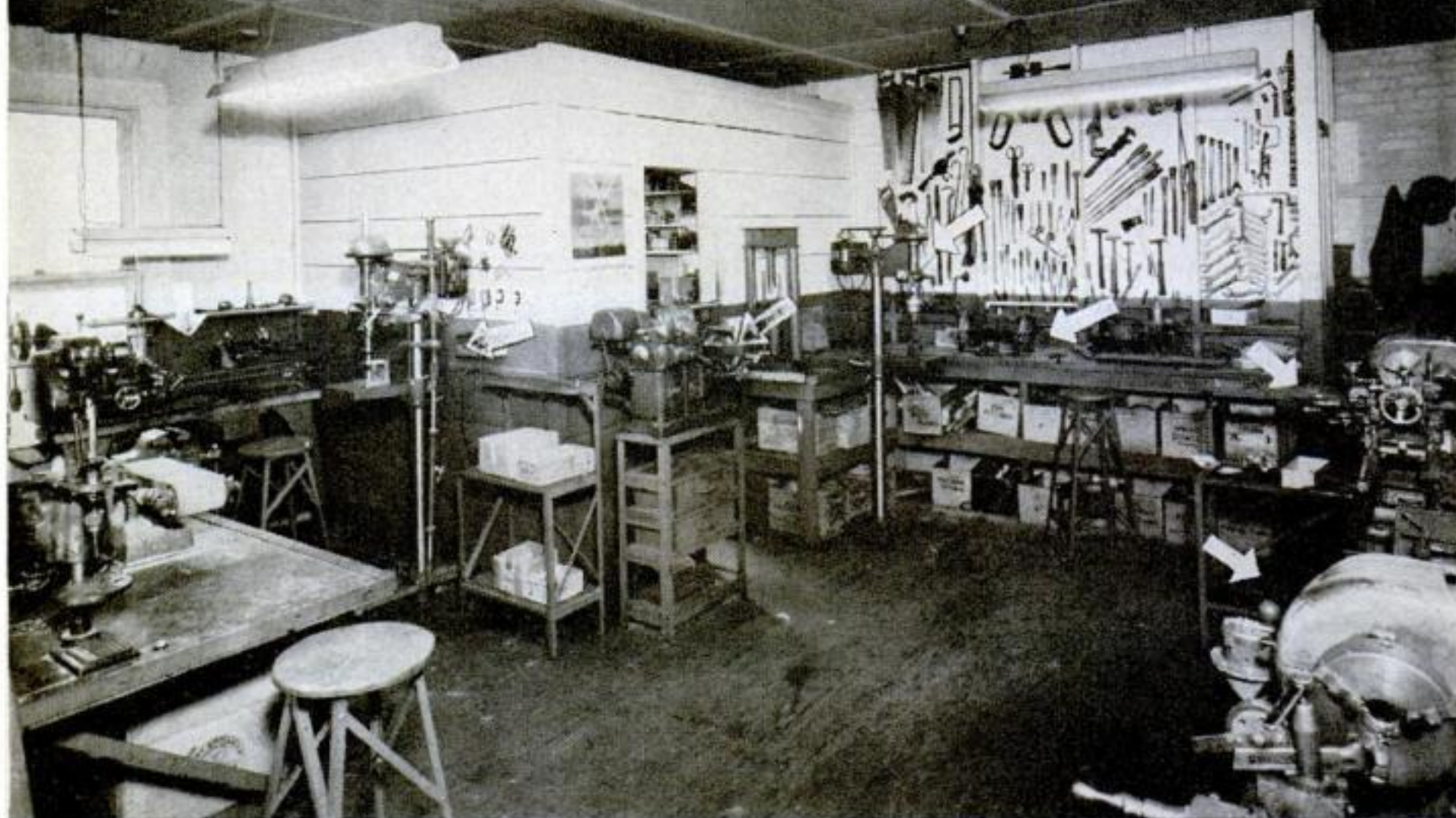
## **HASTINGS** STEEL-VENT **PISTON RINGS**



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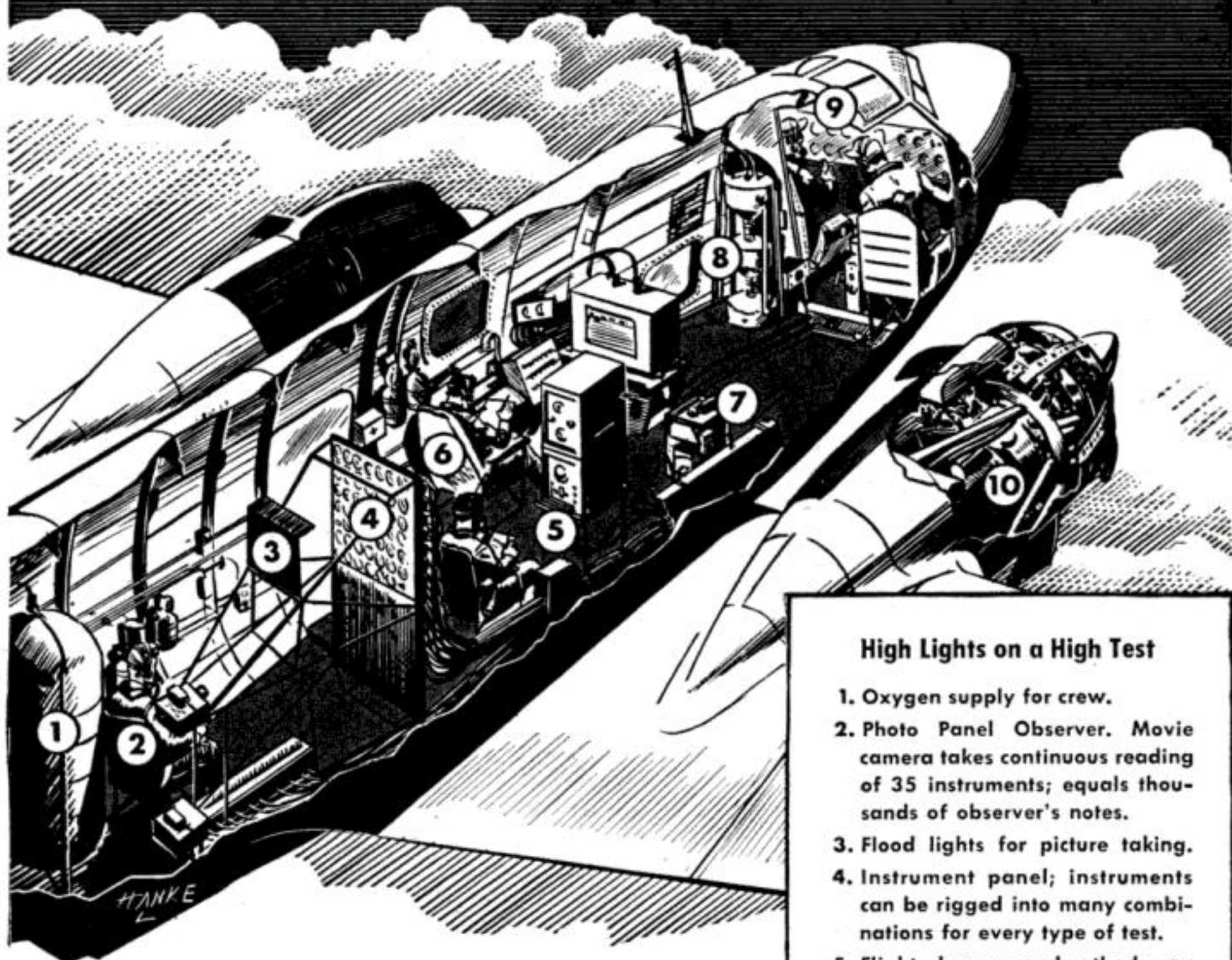


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7. Radio-equipment bay (cutaway to show cabin interior).
8. Volume meter measures fuel consumed during flight test.
9. Pilot and co-pilot observer.
10. Wright Cyclone with cowlings cutaway to show installation.

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Learn more about aviation's source of power. Engineology explains super-charging, combustion and engine principles in non-technical terms; describes their relation to planes and propellers. Just send 25 cents in U.S. coin to:

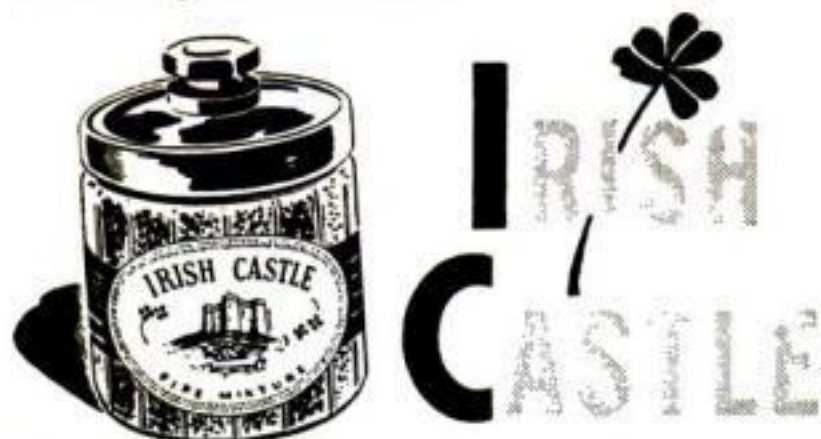
Wright Aeronautical Corporation  
Dept. P.S., Paterson 3, N. J.





## You'll see when you smoke I. C.

You too will be a *wise bird* . . . you too will be *flying high* . . . when you smoke I.C.! How it makes the ladies linger! There's a real reason for that remarkable Irish Castle "aroma-appeal." In fact, there are 8 reasons! Master-blender Willoughby Taylor eyed *all* the far-flung regions of the world and selected 8 top tobaccos to be blended into Irish Castle Smoking Mixture. Turkish for mellowness . . . tangy Virginias for fragrance . . . Latakia for zest, and Perique for spice . . . sound White Burleys for body and satisfaction. *You'll see when you smoke I.C.!*



### GET ACQUAINTED SPECIAL

For a limited time (and only if your dealer is out of stock) we'll send you a half-pound humidor of Irish Castle Pipe Mixture for only \$1.10. Mail coupon with cash or check to Penn Tobacco Co., Dept. PO Wilkes Barre, Pa.

Name

Address

## What's Behind Atomic Power?

(Continued from page 210)


plants totaling an output of 500,000 to 150,000,000 kilowatts would be needed to turn out a couple of pounds of plutonium daily.

In one of the most sensational gambles of all time, the high policy makers at Washington—meaning the President of the United States and his top military advisers—decided the moment had come to push in stacks of big blue chips. Mass-production plants costing fortunes apiece, would rise at once to produce our new atomic explosives. Not a moment could be spared on pilot plants of intermediate capacity. We would go in one breath-taking leap from a mere pinhead of production to making atomic bombs.

Mutual agreement between Prime Minister Churchill and the late President Roosevelt led to the selection of America, far from danger of bombing, to put theory into practice. To make U-235, more calutrons than the University of California ever dreamed of were assembled in a great factory of the Clinton Engineer Works. To speed matters, each calutron had been made to do the work of several by equipping it to produce a series of multiple beams instead of a single one. Now, too, early exploration of every conceivable way to make U-235 proved its worth. A "thermal diffusion" process had been bettered only slightly by the electromagnetic process using calutrons. Now the best parts of each were combined, and a thermal-diffusion plant fed enriched U-235 to the Clinton calutrons, with a corresponding gain in total output. This efficiency has been constantly improved since the Clinton plant went into large-scale production of U-235 during the winter of 1944-1945.

(Continued on page 218)

### Model Builders Attention!



	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

## CHAMPION

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## THAT BELONG TOGETHER

*Airacobras*



*Avenger*



*Corsair*



*Hellcat*



*Lightning*



*Mustang*



*Thunderbolt*



*Black Widow*



*Wildcat*



"Airacobras, Avenger, Corsair, Hellcat, Lightning, Mustang, Thunderbolt, Black Widow, Wildcat"—these and other equally descriptive fighting names were the scourge of the vaunted Luftwaffe—have ~~all~~ but cleared Jap-infested skies. There's one more name common to all of them that just naturally belongs with such a world's champion team—and that is CHAMPION Spark Plugs.

The Champion Spark Plugs you buy for your car are blood brothers to these aircraft Champions. Naturally they insure an extra measure of performance, economy and dependability in every engine.

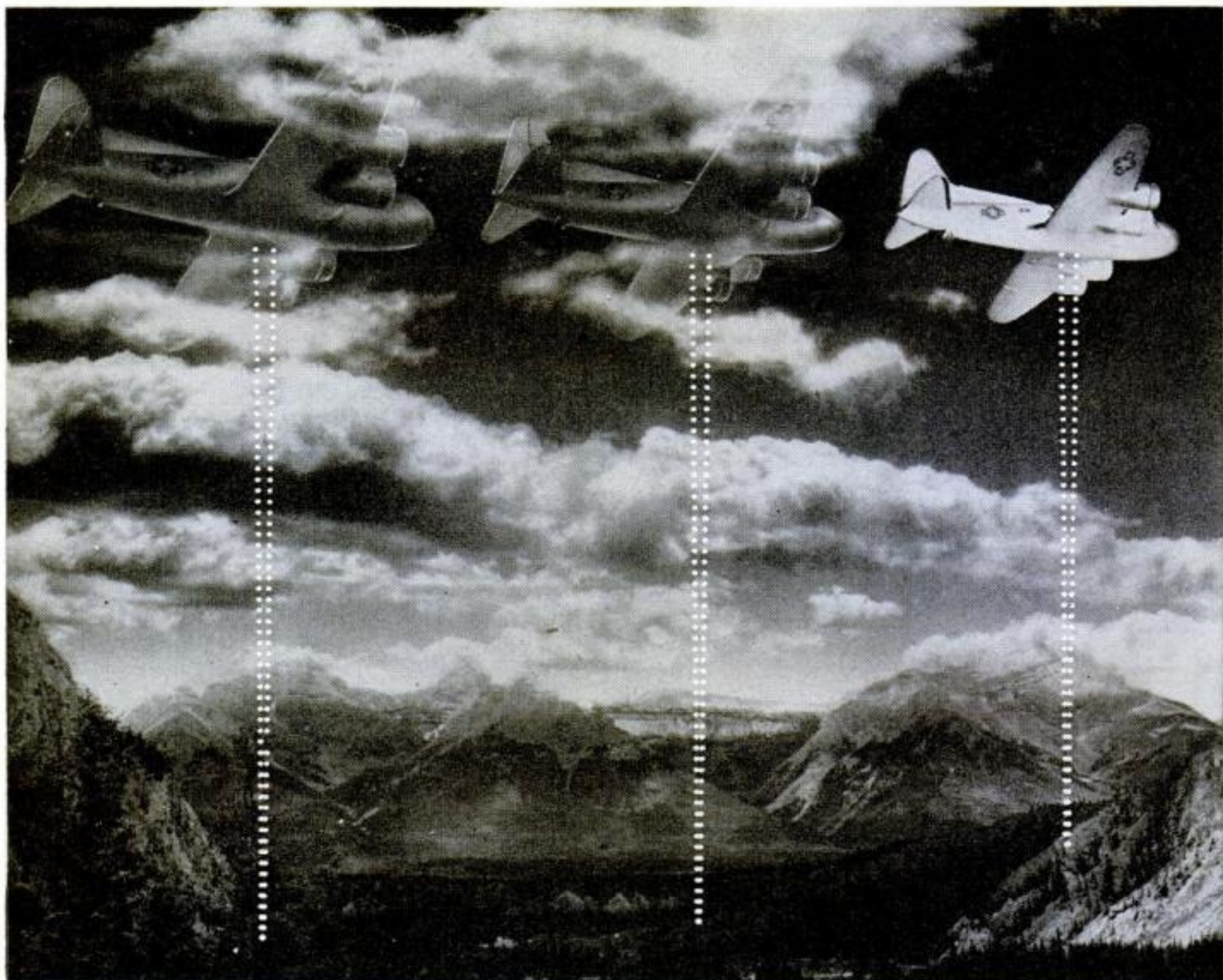
CHAMPION SPARK PLUG COMPANY  
TOLEDO 1, OHIO



# CHAMPION SPARK PLUGS







The RCA Radio Altimeter assures that the last mountains have been passed before letting down to the airport in the valley below.

## Measuring "every bump on the landscape" —at 20,000 Feet!

A radio altimeter—indicating exact height above land or sea—is another RCA contribution to aviation.

Old-style altimeters gave only the approximate height above sea level—did not warn of unexpected "off-course" mountains.

To perfect a better altimeter was one of science's most baffling problems. So RCA developed an instrument so accurate it "measures every bump on the landscape" from the highest possible altitudes . . . so sensitive it can measure the height of a house at 500 feet . . . and "see" through the heaviest fog or snow.

All the radio altimeters used in Army, Navy and British aircraft were designed and first produced by RCA. This same pioneering research goes into *every* RCA product. So when you buy an RCA Victor radio, Victrola, television receiver, even a radio tube replacement, you enjoy a unique pride of ownership. For you know it is one of the finest instruments of its kind that science has yet achieved.

Radio Corporation of America, Radio City, New York 20. Listen to *The RCA Show, Sundays, 4:30 P.M., E.T., over the NBC Network.*



The RCA radio altimeter is a major contribution to the safety of commercial flying. The section at the left sends the radio waves to earth and back again while the "box" at the right—timing these waves to the millionth of a second—tells the navigator the plane's exact height in feet.



**RADIO CORPORATION of AMERICA**





When papered walls begin to peel  
From age or from the heat,  
A strip or two of Texcel Tape  
Will keep them looking neat.  
(Texcel won't creep loose—the "stickum's" bonded on!)

The kitchen curtain starts to rip?  
Don't let that bother you.  
Quick! Take a strip of Texcel Tape  
And mend it good as new.

(Texcel mends securely—the "stickum's" bonded on!)



So many things about a house  
This Texcel Tape can do—  
From wrapping up to fastening down  
In place of string or glue.

(Texcel holds and holds—the "stickum's" bonded on!)



Yes, Texcel is an improved tape  
Whose "stickum's" bonded on!  
It won't come off, it won't dry out,  
It holds with lots of brawn.

**S**o make a mental note right now  
Though cellophane tape's at war,  
That improved Texcel Tape will be  
The first brand you'll ask for.



# Texcel Tape

REG. U. S. PAT. OFF.

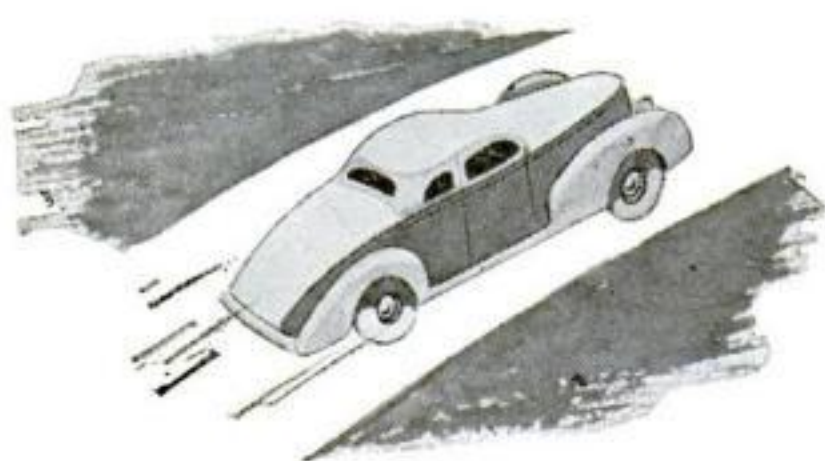
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**LOOSITE** and **SILOO**, swift-working solvents of petroleum residues act quickly and safely to eliminate sludge, gum and acid. **LOOSITE** cleans out the engine—then **SILOO** added to fresh crankcase oil keeps it clean. A simple, harmless, economical method of obtaining maximum performance and longer life from your car.

Ask your garage, service station or auto dealer for the **LOOSITE** and **SILOO** treatment—then notice the way your engine responds. Your car will run better and last longer.

If you heat with oil — write for information on  
**SILOO FUEL OIL TANK SOLVENT.**

**PETROLEUM SOLVENTS CORPORATION**  
331 Madison Avenue, New York 17, N. Y.

# What's Behind Atomic Power?

(Continued from page 214)

Simultaneously, the experimental pile for producing plutonium at the University of Chicago had given rise to giant counterparts at the Hanford Engineer Works on the Columbia River in the State of Washington. Conveniently close at hand, the river provided the huge volume of pure, cold water required to cool the immense graphite-uranium piles.

Permanent carbon piles, which do not have to be dismantled after use, have been found best for mass production. Pure uranium rods, instead of lumps, pass through cylindrical channels in the pile. This facilitates inserting and removing them by remote control, for no one can approach the dangerous radiation from the piles. The raw material, uranium, is not dangerously radioactive. Neither is plutonium, unless it gets into the body, where its rays and chemically poisonous character make it one of the most deadly substances known. But the real trouble comes from some 30 other elements, including radioactive xenon and radioactive iodine, released when the uranium atom is split. Therefore, workers are shielded from each pile by thick walls of concrete or other protective means, while special precautions assure that neither waste water nor stack gases will contaminate the river or air.

Plutonium-bearing slugs of uranium, on their way to the separation plant, still show intense radioactivity. So they are passed through a "canyon," heavily walled with

(Continued on page 222)

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all our lives made *BRIGHTER***

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**1. We're going to have Perfection Oil-Burning Heaters** to keep the whole house warm and livable in winter. Warm without work or dirt. Think of it! Dial control will give a degree of heat we want—much or little! Heat-directing shutters send warmth where we want it. Blower and humidifier extend heat range and increase home comfort!

**2. We're going to have a Perfection Oil Range—** and that means a bright, cheerful, convenient kitchen! I'll cook better meals because each of the "High Power" burners will give me instantly the degree of heat I need for best results. The "Live Heat" oven will improve my baking. We're going to get Perfection's odorless, sootless, effortless cooking heat! And through Perfection—time for better living!

**3. We're going to have Hot Water—** all we want of it conveniently on tap all the time—thanks to the modern Perfection Oil-Burning Water Heater. No more hazardous heating in kettles and hauling for us—not with Perfection!

*Only limited models available at present.*

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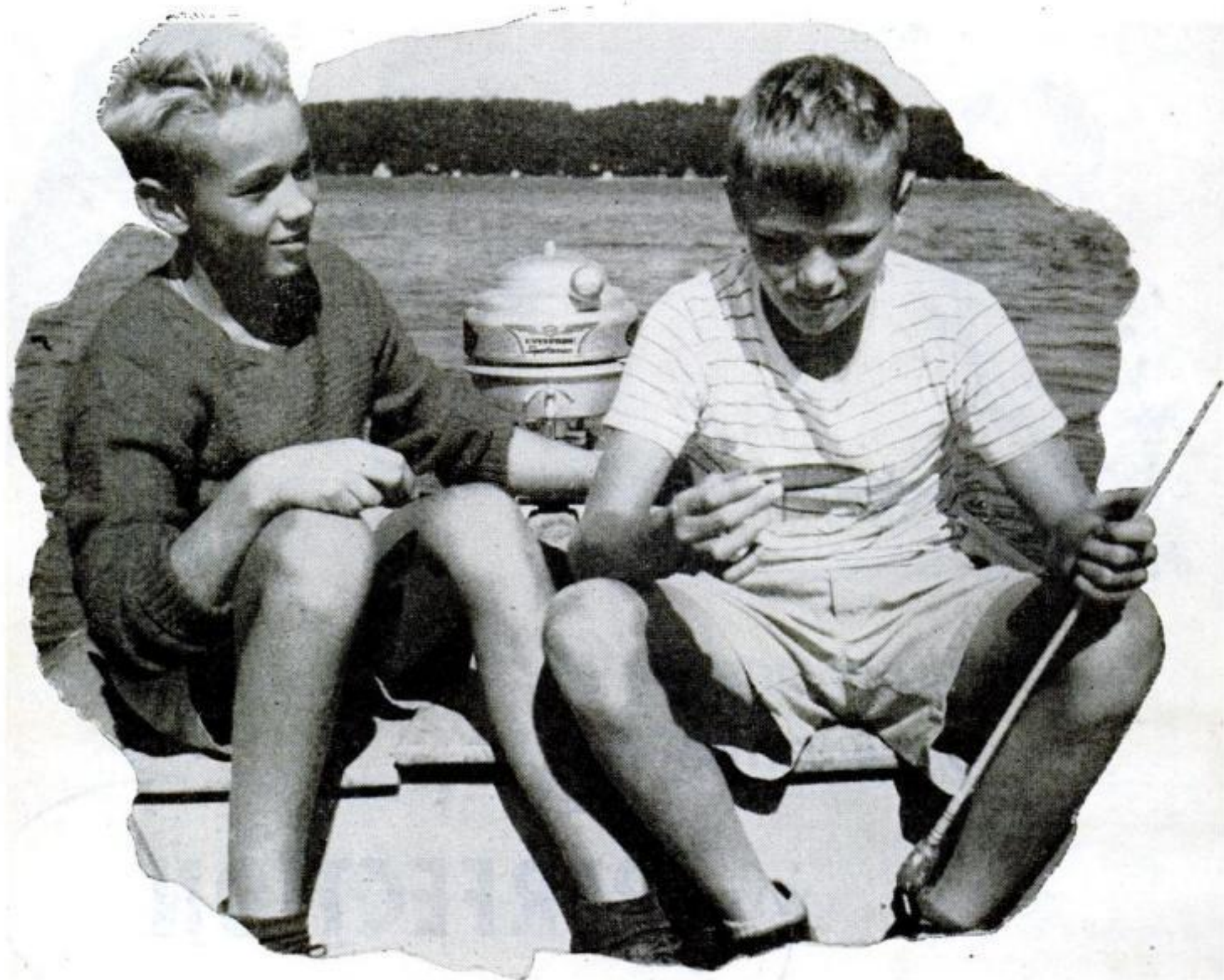
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*Getting out on boats* is a grand thing for boys. It makes them water-wise and "fish-wise", clear-thinking and resourceful in emergencies. It nurtures all the priceless qualities that make for manliness and good sportsmanship.

*Getting out on boats* is also a great thing for outboards. In fact, it means just about *everything* in developing and perfecting truly fine outboard motors. And this is the overshadowing advantage Evinrude offers. 36 years of *getting out on boats* . . . 36 years of studying, testing, proving and improving countless models on thousands of boats of every type . . . from humble fishing skiffs to spectacular assault craft. Matured, perfected, *completely satisfying performance* is something you can bank on . . . when you choose a postwar Evinrude! EVINRUDE MOTORS, Milwaukee, Wisconsin.

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OUTBOARD  MOTORS

POPULAR SCIENCE





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Ordinary watches stop running in about 36 hours. But Croton Aquamatic winds by itself—natural motions of your wrist keep it wound. Wear it night and day—it won't "run down".

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In a 30-day comparison test recently completed by an impartial laboratory, Croton Aquamatic achieved astonishing accuracy compared to the average of nine nationally-famous stem-wind watches. Three Croton Self-Winding Aquamatics proved 13.5% more accurate. Wear it when you swim or bathe—it's waterproof. Added features: shock-resistant, unbreakable crystal, sweep second hand, radium dial. All the things a man wants in a 17-jewel watch (plus self-winding) for only \$49.50. Fed. Tax Incl.

P. S. Write for free Booklet K20  
Croton Watch Co., 48 W. 48th St., N. Y. 19

**Croton** SELF-WINDING

**WATERPROOF AQUAMATIC**

## What's Behind Atomic Power?

(Continued from page 218)

concrete and almost completely underground, consisting of a row of cells where they are dissolved, centrifuged, or precipitated, all under remote control from above ground. Eventually, a solution or precipitate of plutonium, freed of all impurities, is obtained. Success of this operation has exceeded all expectations. The first pile began operating in September, 1944, and all three piles—widely separated for safety—were working by the summer of 1945.

Perhaps no spot farther from the beaten trail could be found than the site of Los Alamos, in New Mexico, on a mesa about 20 miles from Santa Fe. Here was secretly set up one of the finest physical laboratories in the world, accessible only by a winding mountain road. It was to be the birthplace of the first atomic bomb. Nobody knew how to make one—but here they had ideas.

One of the most perplexing problems was how to detonate the bomb. Suppose, it was suggested, that pieces of uranium 235 or of plutonium were arranged in a lattice, so that they would be just too small or too far apart to explode spontaneously. Now imagine that a supplementary piece was added to one of them, increasing its size and starting a chain reaction. Wouldn't there be a bang—and nothing left after it?

Some objected. The reaction would go off too soon, and would be all over before it did any damage, if the intruding piece were introduced by ordinary mechanism. All right, then—how about shooting it in with something like a gun? Pencils came out and scribbled equations. Yes, it looked reasonable, but you would have to try it.

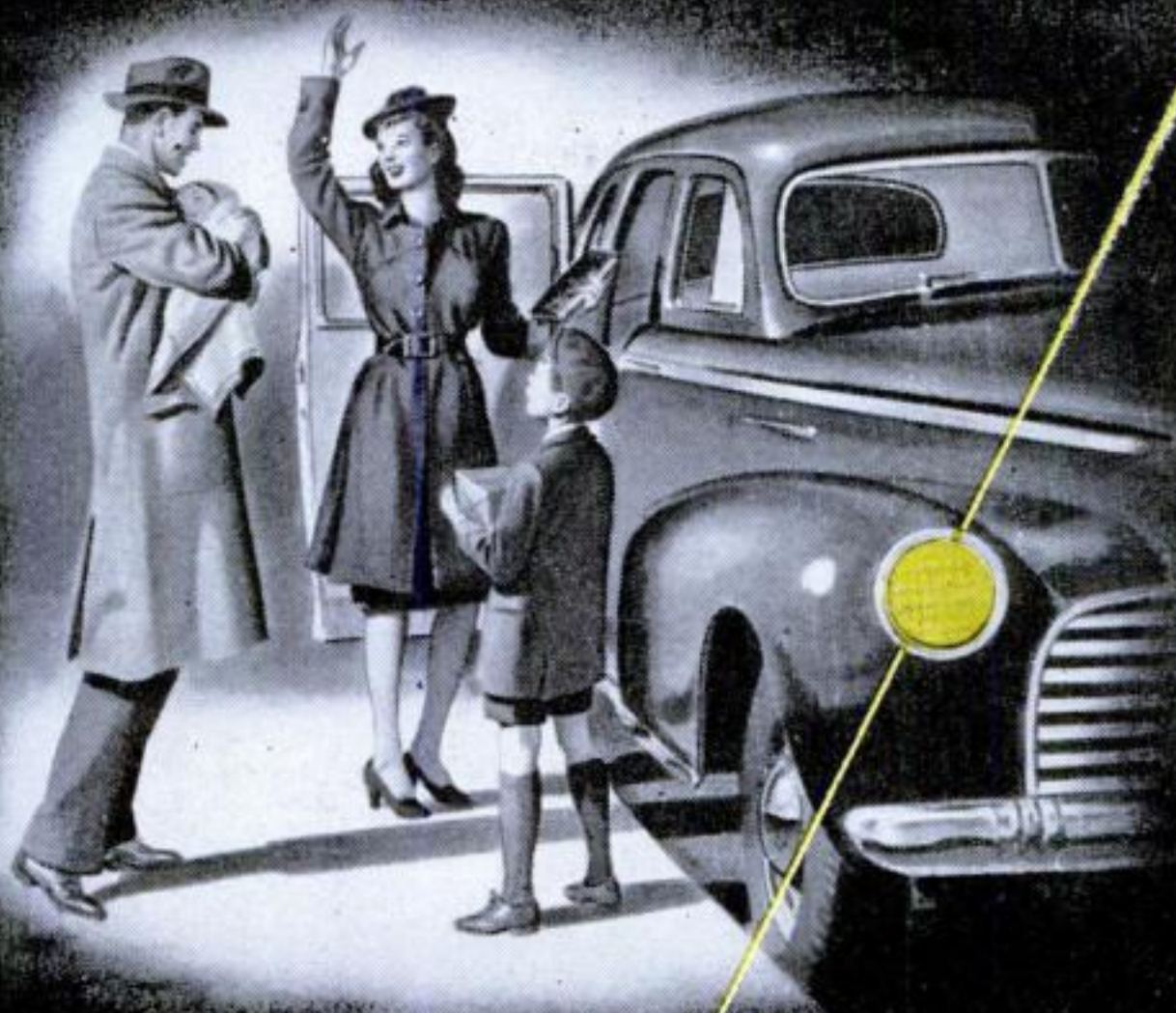
The materials from the East had arrived. Experts assembled a model of an atomic bomb and hung it from a steel tower. Spectators were shooed back to safety miles away. A blinding flash lit up the plain like lightning. The tower had vanished in vapor. Some of the observers were bowled head over heels. None told what he had seen.

Then came the news flashes. An atomic bomb equivalent to 20,000 tons of TNT had wiped out the Jap army base at Hiroshima. A second one devastated Nagasaki. Japan surrendered. World War II was over.

Was it worth \$2,000,000,000—the figures are President Truman's—to drop these two bombs? It would be a bargain, if only to shorten the greatest world conflict that history has seen. But it has done far more than that. It has clinched man's mastery over the atom's giant power, for untold good or evil as he may choose to use it.



*When carrying precious cargo...  
you're safer with  
Guide Sealed Beam Units*



KEEP BUYING  
WAR BONDS

Guide Sealed Beam headlamp units are "eyes" at night... the safest, surest system of automotive lighting that science and research have yet been able to develop.

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for  
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when we  
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All through this war, thousands of letters have been pouring in from our fighting men on all fronts. In every instance, the letters tell how Harley-Davidsons stand up under severest conditions of heat, cold, mud, rain and snow. Always, the letters end something like this—"Want to get this war over quickly and get back to those good old motorcycling days. A new

Harley-Davidson will be my first buy."

Okay, fellows. The new Harley-Davidsons will be ready soon after the shooting is over. And you can count on it that they will have the same stamina, rugged construction and dependability that made them World Champions before the war — world beaters during the war.

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CLEAN SPARK PLUGS  
SAVE UP TO ONE GALLON  
OF GAS IN TEN

**AC**  
**SPARK**  
**PLUGS**

DON'T LET UP NOW—KEEP ON BUYING  
WAR BONDS — LET'S FINISH THE JOB

## What Next with the Atom?

*(Continued from page 67)*

plished, there would be no real difficulty in transmuting metals and building new, man-made elements of the types that we need.

Electrically driven motorcars have long been attempted; and, if rather inefficient transmission is no disadvantage, automobiles could be driven by cables from "transformers" sunk below the surfaces of all our main roads. Houses could very well be heated by invisible inductors and lighted by invisible lamps. As for cooking, enough energy could be produced from material the size of a pin point to roast a joint every day for years on end.

The greatest disadvantage of electricity still is inefficient storage and the expense of transmission. The not-at-all-impossible problem remains of discovering how electrical particles from fission (separation) can supply us with electricity for industrial uses. At one stroke, this would remove the necessity for central power stations and make it a simple matter to operate electrical apparatus from local energy sources at a cost far below that of any modern prime mover.

Much has been written lately about controlling the weather. The weather is a matter of geological conditions and geographical position relative to mountains, lakes, and seas. Possession of power on a scale almost inconceivable today would make removal of quite an appreciable mountain chain an economic proposition. To destroy an island, create a lake, or dam the Gulf Stream, as proposed by the Soviet Union quite recently, now becomes a question of civil engineering—of great magnitude, it is true.

An area which is usually overcast by clouds might well be broken up by firing rocket bombs into the stratosphere, and one visualizes an extraordinary state of affairs far in the future when nations may have to agree as to the kind of weather that is desirable, and as to whether one country may have fine weather while others suffer the miseries of storms that have been relocated. There is no inherent reason, given unlimited power, why the North Pole could not be warmed and cultivated, or why Sahara shouldn't become an important wheat-growing area with its own heating, lighting, and irrigation systems—all driven from this change of matter into energy.

Above all, let us not waste time by thinking that war can be ended by additional horrors. The power of the atom bomb can

*(Continued on page 230)*





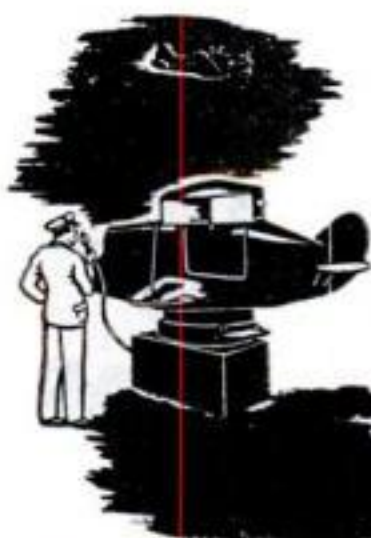
*It was later  
than we  
knew*

ON D-DAY MINUS ONE, time stood still. It was midnight in the Air Force briefing room... midnight on the LST... midnight on the Normandy beaches.

It was late—later than we in America knew. V-2 was dropping out of the skies

without warning. Nazi scientists, hid in the Bavarian mountains, were working on 3000-mile rocket bombs. It was late...but the United Nations were ready.

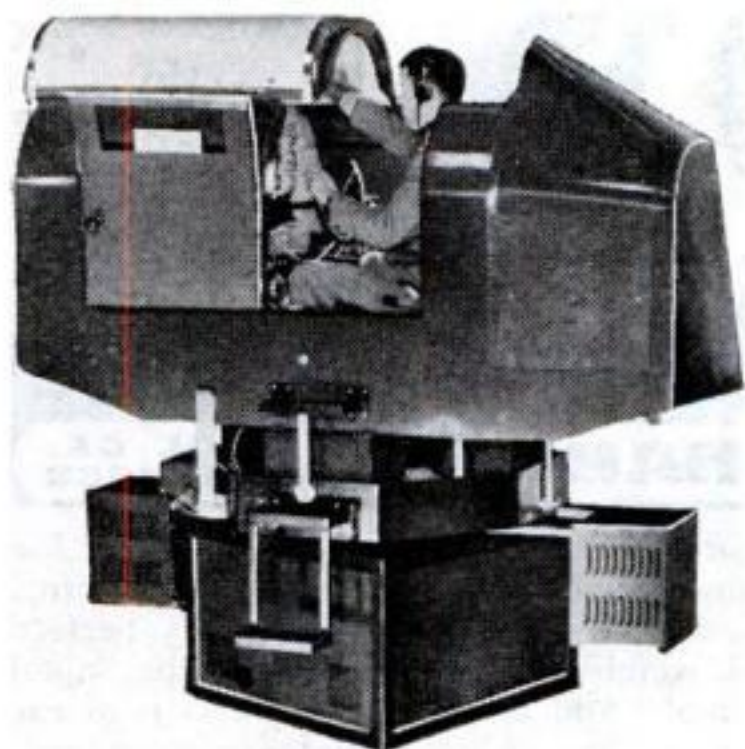
We were ready, for one thing, because we owned the air. Our phenomenal plane production had been matched by our output of trained pilots and crews. And the manning of our air armada was made possible, in no small measure, by Link training. Here's how Link Trainers—standard with our Air Forces—save lives, time and money:



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*Link Trainers, steadily improved to keep pace with advances in aviation, will continue to be a key factor in the preparedness of our Air Forces.*

**Link**  
**Aviation Devices, Inc.**  
BINGHAMTON, N.Y.

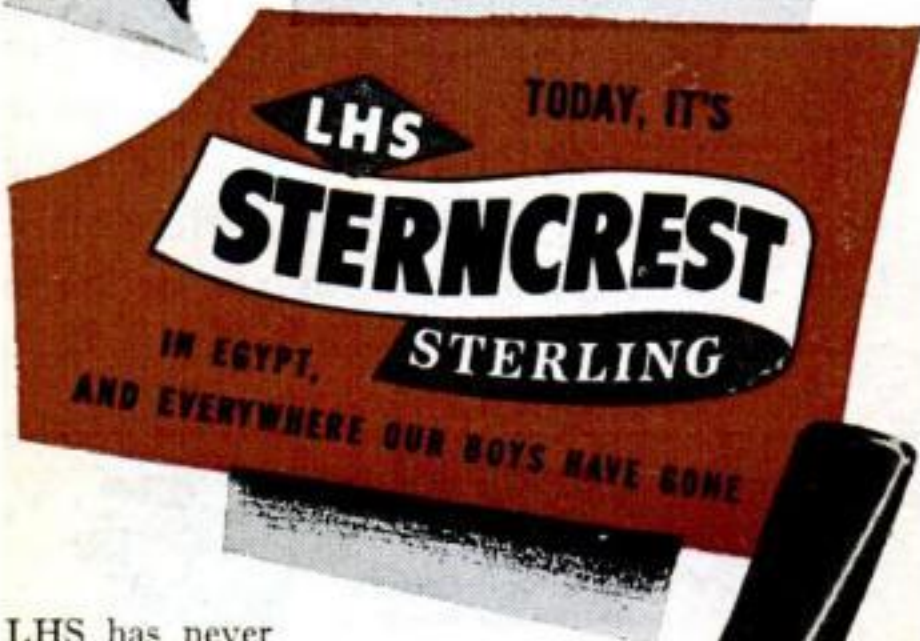
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IN  
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Also in plain finish.  
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POPULAR SCIENCE



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2.



**Smooth as satin** tonal realism will be a feature of Zenith F-M radios. You'll hear music and voices against a backdrop of velvety silence. No electrical noises, no distorted sounds... just pure, uninterrupted listening pleasure. When you hear it you'll agree it has the touch of genius.

3.



**Genuine F-M... not imitation**... Zenith collaborated with the originator in bringing F-M to its present peak of perfection. Through long experience in operating its own 50,000 watt F-M station, and through important new Radionic developments, Zenith will have F-M radios with the touch of genius.

4.



**No overlapping or fading stations** with genuine Zenith F-M. It will be as superior as a sharp photograph is to an out-of-focus snapshot. Each F-M station will tune in with razor-sharp precision and stay on the beam until you turn the dial.

5.



**Records come alive!** First, Zenith's new way to reproduce record music ends all needle-noise, scratch and rattle. Then, the music goes through the static-free F-M radio circuit. The result—all the hidden beauty never heard in records before, plus the tonal realism of F-M.

Naturally a Leader in F-M  
Because  
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Following the discovery of F-M (Frequency Modulation), Zenith joined with the originators in its development. In fact, Zenith's 30 years of concentration on Radionics Exclusively has played a vital part in bringing genuine F-M to its present perfection.

This vast reservoir of experience in Radionics—the science of radio waves—has led to amazing achievements in manufacturing F-M devices for the armed forces. And all Zenith's wartime discoveries will be incorporated in the coming new Zenith F-M Radios and Radio-Phonographs.

When you see and hear them, you'll know instantly that there's a touch of genius in everything Zenith does.

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famous since 1909  
for QUALITY,  
STYLE and  
SERVICE



BRIGHT STAR BATTERY CO. CLIFTON N. J.

## What Next with the Atom?

*(Continued from page 226)*

be made a power for good only by general desire, never by law. It is not many months since the world listened to various important people propose to maintain peace by the simple process of barring warlike nations from "strategic" materials. They apparently did not have the imagination to realize that tungsten, nickel, and cellulose may be of little more value in 20 years' time than the materials needed to make bows and arrows.

There is no more reason why the new bomb should abolish war than there was for gunpowder, a few hundred years ago, to produce peace in the era of swords and pikes. It is, perhaps, a useful commentary upon modern civilization that the devastation of Europe recently accomplished was but little greater than was inflicted more than a century ago; the only visible difference is that this task took our forefathers 25 years whereas we have been able to do it equally well in less than six years.

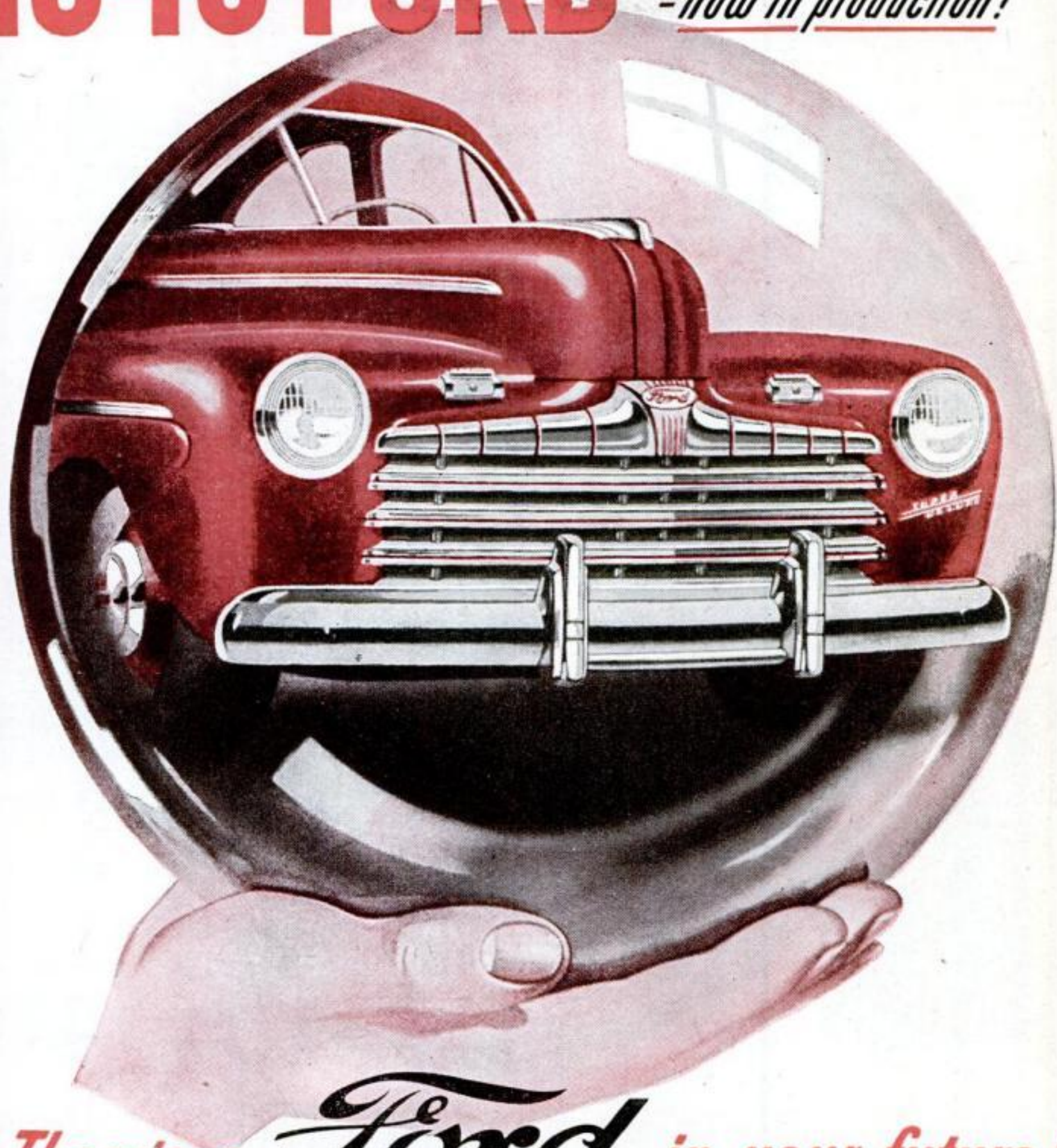
Let us now look farther ahead than merely attempting to think belatedly of new methods of defense and wondering if some local radioactivity can explode atomic bombs before they leave the enemy's factory. We have heard that the atomic bomb cost \$2,000,000,000. It is difficult to think of any peace project which would have received such enthusiastic support. But this development offers scientists at least one hopeful thought—secrecy is quite impossible. Given a comparatively small sum, no nation will have the slightest difficulty in solving the problem of this bomb.

The problem of controlling atomic power is far more difficult—but that, too, we will achieve. It will bring opportunities and luxuries—streets and clothes warmed by electricity, better food, enormously important medical advances—and many more things for which the heart of man has yearned for many years.

Given freedom of research, at a fraction of the cost we have devoted to war, we may eventually reach a time when the process of converting matter into energy will be reversed. Partial creation of uranium elements is a small example. Success may one day bring transference of matter via the ether into the realm of practical physics. One is tempted to suggest that sooner or later—although it may easily be disproved in our present happy state of ignorance—the "broadcast" of a pound of sugar to a suitable receiving station will be the day's big news in the world's newspapers.



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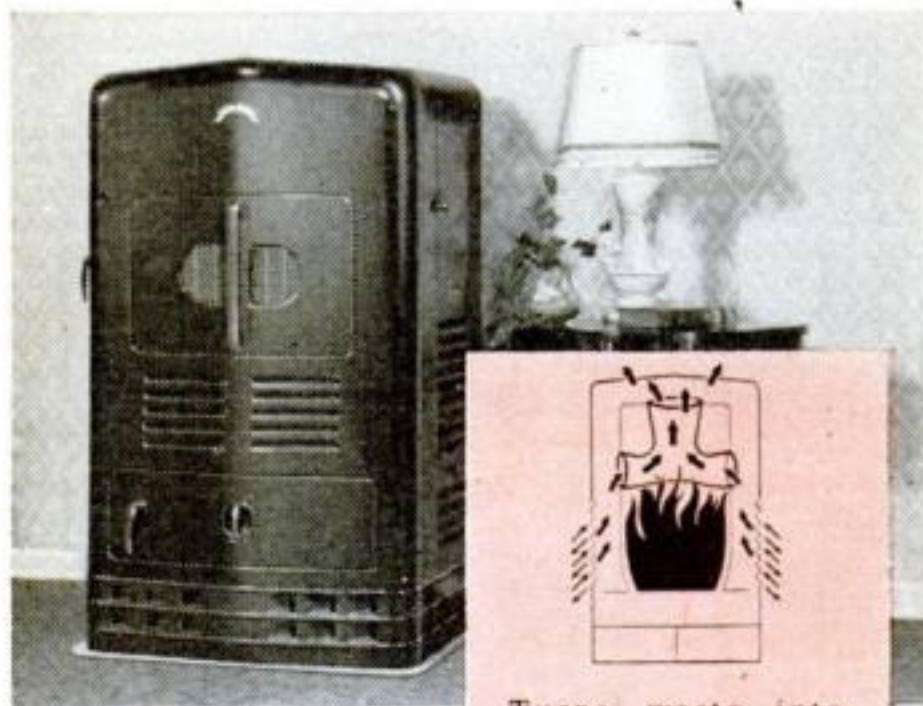
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## How Radar Will Help You

(Continued from page 87)

there is no reason why this system should not be used also by land surveyors, particularly in rough, unexplored country where it may be difficult to set up a transit or measure a base line with rods and chains.

One requisite for safe aerial navigation is a knowledge of the plane's altitude above the nearest terrain. For this there is a working answer in the "absolute altimeter," a simple kind of radar that projects its waves downward and measures the time required for their return from the nearest ground. Another safety problem—prevention of collisions with other airplanes—can be solved by adapting one kind of radar used by combat planes. Also used in the war was a small and simple radar known as TW—for "tail warning"—which is placed in the tail assembly and rings a bell to warn the pilot if another plane is approaching from the rear. Turn one of the "tail warnings" around and have it face forward from the nose or a wing of the plane. Then, as you flew blind through a cloud, a bell would ring if you were coming within range of collision with another plane, or if a tall structure happened to be in the way.

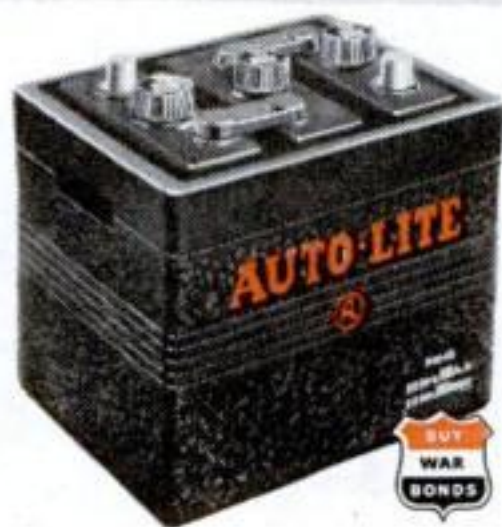
Everything that has been said about airplane safety and navigation applies also to surface vessels, except that ship navigation by radar is easier for two reasons: first, because the ships move so much more slowly; and second, because altitude finding is out of the picture, since ships are always at sea level. Besides, ships can mount heavier equipment, such as search radars that will show coastlines, projecting rocks and reefs, harbor buoys, icebergs, and other ships.

Eventually, as radar systems are greatly simplified, some adaptation of the interrogator-beacon system might be used to prevent collisions of automobiles and railroad trains. For instance, for use in fog, every automobile and train might some day be required to have an interrogator installed alongside its headlights and transponders installed both front and rear. Thus there would always be warning against either a rear-end or a head-on collision. But this is not likely to be a thing for today or tomorrow. Radar equipment will have to become a lot cheaper before we can expect its installation to be required by the various state motor vehicle bureaus. At any rate, some such system appears much more practical for the foreseeable future than the wild ideas voiced in some quarters about having a televisionlike screen in your car that would show every fence post ahead.



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## Compulsory Training

*(Continued from page 93)*

they can make a single effective hit. But the point is that navies will be needed just as long as sea transport is the cheapest and most effective means of transporting bulk freight. The sea is primarily a highway, and sea warfare is for the single purpose of getting the free use of that highway for oneself, whether for military or commercial purposes, and denying it to the enemy. Now let's get back to our trainees.

Of the 650,000 trainees who go each year to the Army, some 40 percent will be assigned to the Army Air Forces, 35 percent to the Army Ground Forces and 25 percent to the Army Service Forces.

Every one of the trainees will get a period of basic training—about nine weeks. That period will be the same for the Navy and the Marine Corps. During this period the young man will learn how to take care of himself, his uniform, and his basic equipment; he will be taught the rudiments of drill, first aid and personal hygiene, military courtesy and discipline, and various other basic subjects. He will get physical training daily, and he will have to do some marching. (The foregoing is the Army basic training; in the Navy it will be a little different.)

After that, the trainee begins specialized individual training. And that is where the drill sergeant, old style, fades out of the picture and the scientific drill sergeant takes over. A year is just about time enough to train a young man in one special job—one of the innumerable specialties which are necessary for the operation of the vast and complex technical mechanism of a modern fighting force.

If he is in the Navy, he may be a gunner's mate, signalman, machinist's mate, fireman, painter, telegrapher, cook, or one of a host of other specialists covering almost every possible kind of job.

Now, how about the Army?

Take the Army Air Forces first. Basic training, of course—and a lot of physical tests to see if the lad is fit for flying duty. If so, he may learn to be an aerial gunner, a flight engineer, or a radio operator. If he has the necessary physical and mental qualifications, he may be picked as material for pilot training, but to get that he will have to accept a further period of service, take a pilot's course, and qualify for a commission. If he is not picked for flying duty, he may learn to be an armorer, machinist, metal worker, welder, or one of a number

*(Continued on page 242)*



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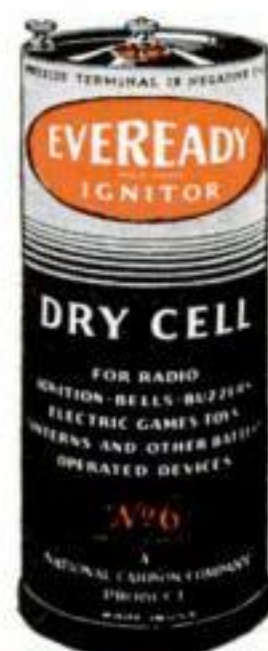


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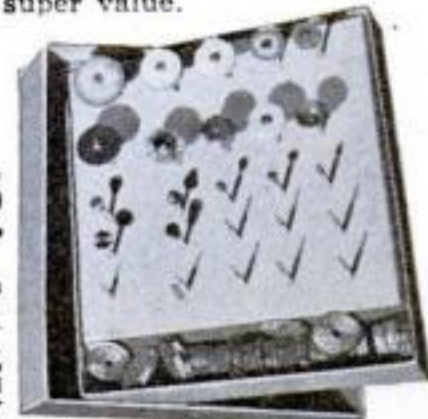
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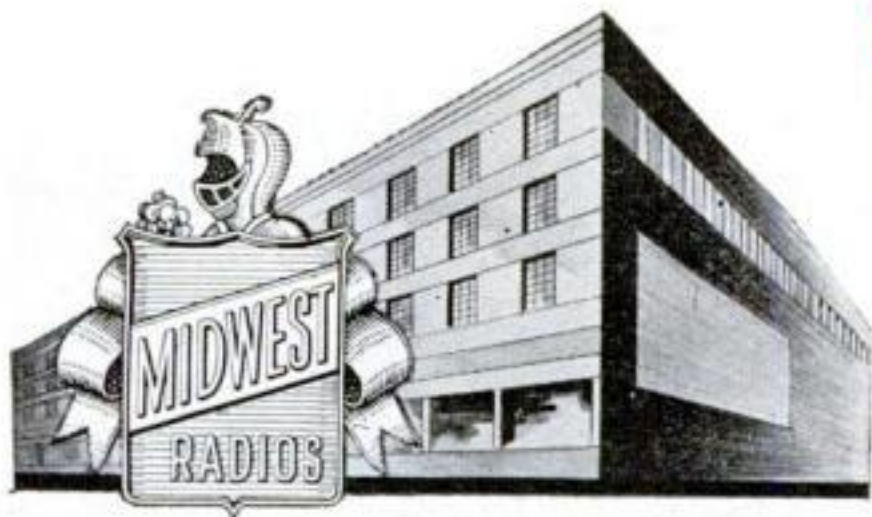
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## Compulsory Training

*(Continued from page 238)*

of other specialists. Where's that drill sergeant? He's still pretty scientific.

And when we look at the Army Service Forces, we find the same demands for specialists in the Adjutant General's Department, the Signal Corps, the Medical Department, the Chemical Warfare Service, the Transportation Corps (rail, water, and truck), the Ordnance Department, the Quartermaster Corps, the Finance Department, and the Corps of Military Police.

Finally, we come to the Army Ground Forces. Here the principal emphasis will be on the handling, use, and maintenance of weapons and equipment, as far as individual training is concerned, and will include airborne practice.

Of course, individual training will have to be combined with team training to some extent. The individual rifleman must be taught to function as a member of a squad, and the individual squad to function within the platoon and the company. Just so, the individual air mechanic must learn to function as a member of a ground crew for a given plane, and the ground crew must learn how to work as part of a squadron. Toward the end of the year will come large-unit training, in which the trainee will be able to see what his part is in the big team, and extended field exercises will bring the year to a close. This again is the Army; in the Navy, the final windup will be a long cruise at sea, with appropriate maneuvers and exercises.

The thought I'd like to leave with you is this: these young men will be trained to defend their country, if need be, with the most modern weapons and devices. Even while they are training, a national research and development agency will be hard at work improving on the weapons they are using, devising better methods, testing out every new invention and discovery. Each year's batch of recruits will have something new; but the individual basis of training remains sound and useful. It will be useful to the nation as a protection and a support; it will be useful to the individual who receives it in all his after life, for we live in a scientific and mechanical world where the scientific drill sergeant has his place in peace as well as in war. For every American boy to live for a year with machines, tools, gadgets, and instruments — using them, repairing them, servicing them—will be a good thing for the boy and a good thing for the country: and that is exactly what "military training" means nowadays.





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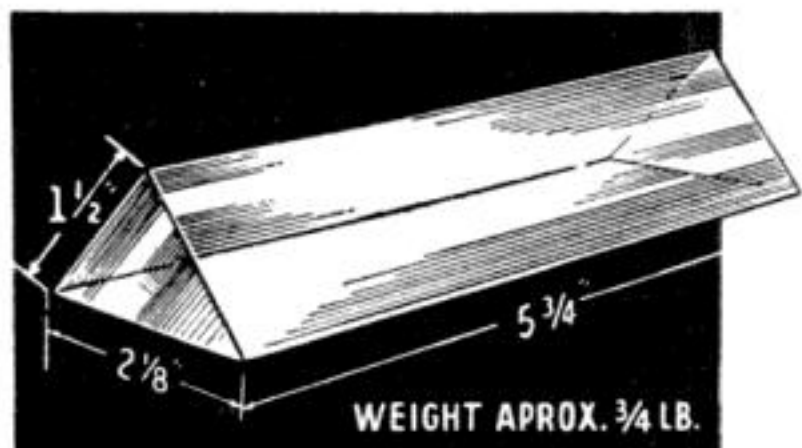
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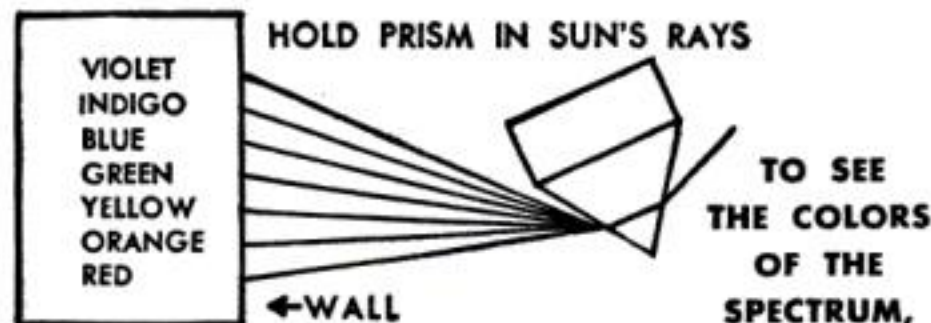
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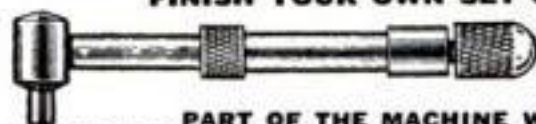
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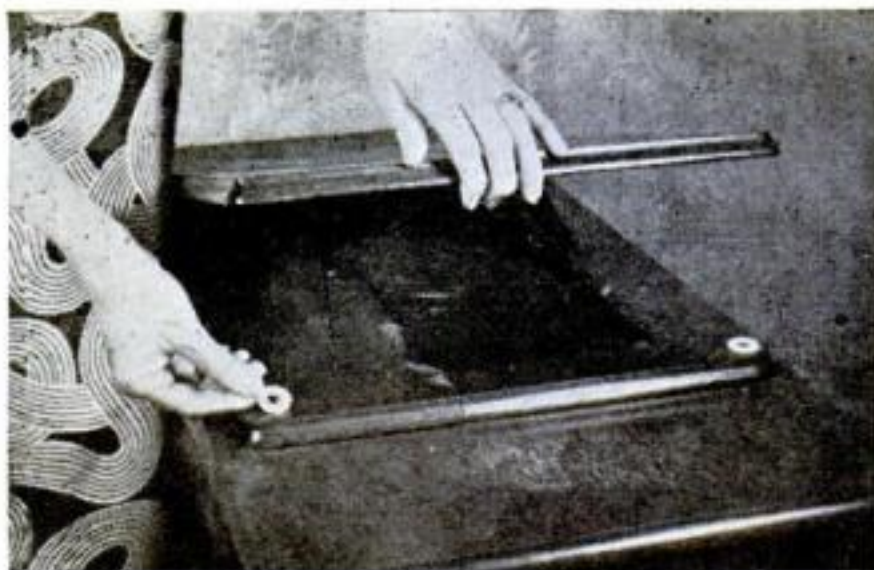
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## Corn Pads Prevent Marks on Case

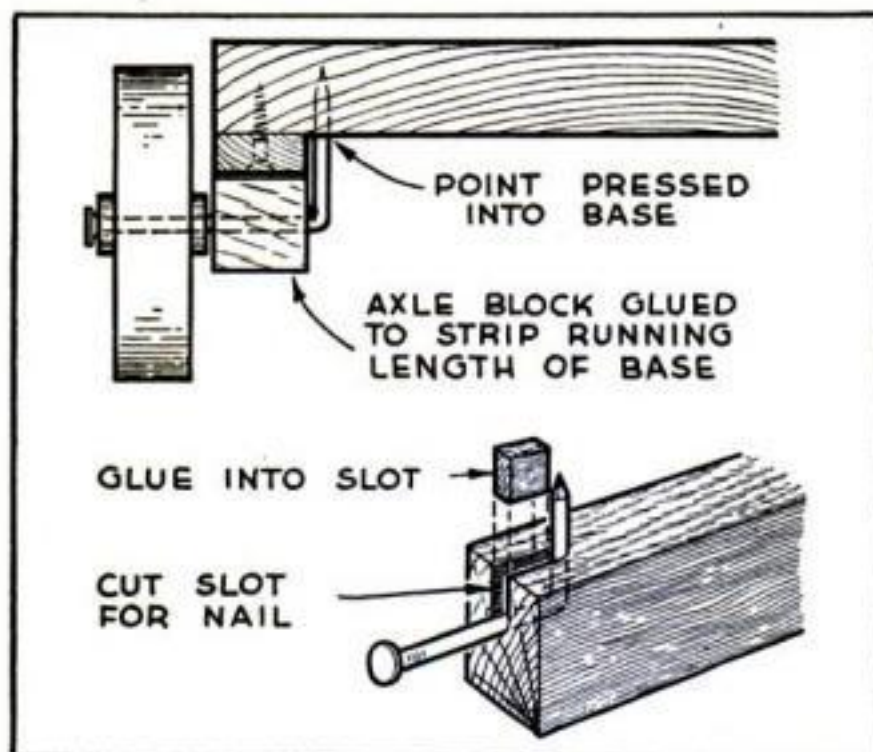
FELT corn pads attached to the top of a sewing-machine case at the points where the lid corners close down will prevent the unsightly marks that often appear there after a time. If the pads are colored, they will be less conspicuous.—BENJAMIN NIELSEN.

## Oxalic Acid Lightens Dark Wood

WOOD that is still dark after an old finish has been taken off with paint remover can be further lightened by applying a solution made of 1 oz. of oxalic acid crystals dissolved in a pint of alcohol. If the color is deep, it may be necessary to add more crystals. After applying the solution, allow it to remain overnight. Then wash off with clean alcohol.—JOSEPH E. BIRD.

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WHEN a nail is used as the axle for a small wooden wheel on a toy, it can be anchored securely by bending to a 90-deg. angle and driving the point into the underside of the base. Two ways of mounting a wheel by this method are shown in the illustration below. In either case, the wheel should be placed on the nail before it is bent and attached to the toy.—EDGAR TANNER.





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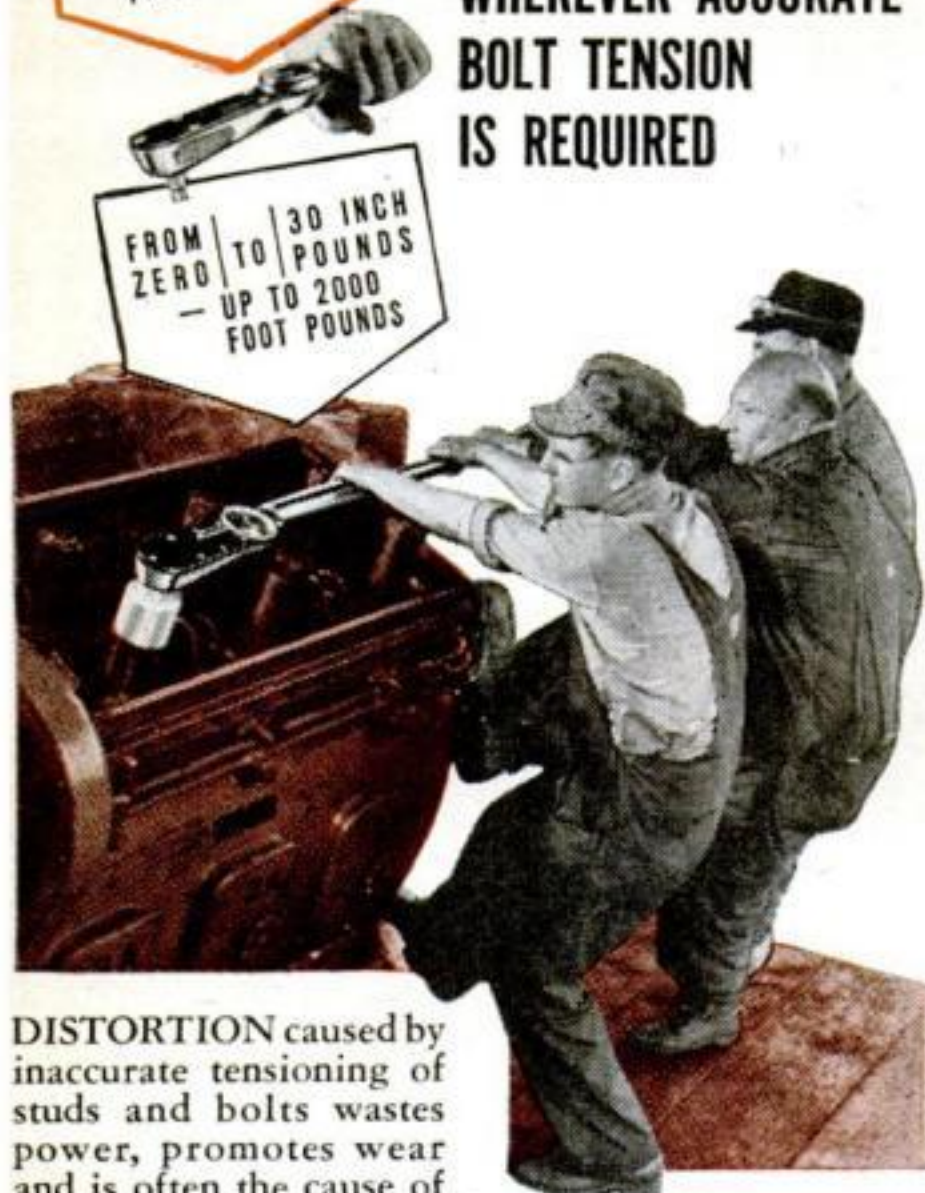


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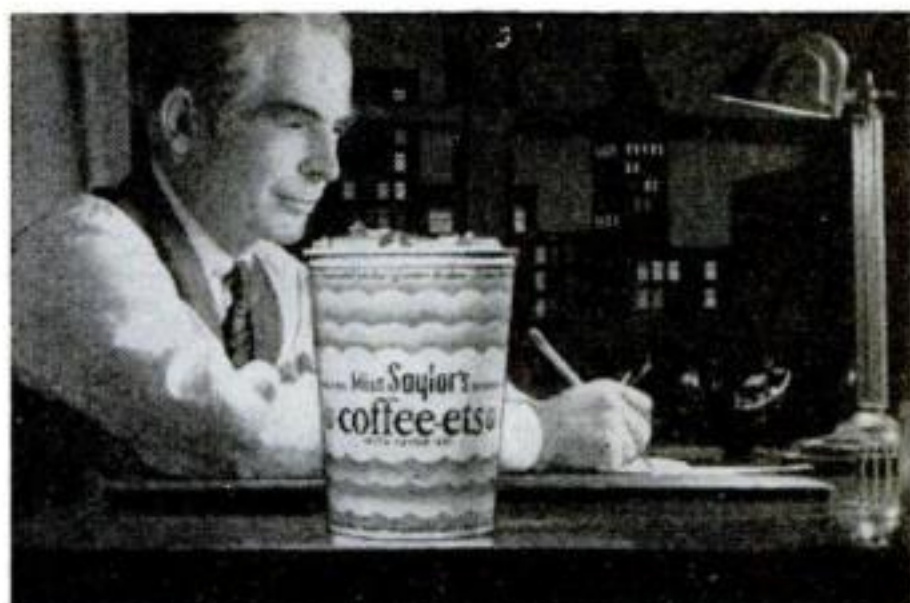
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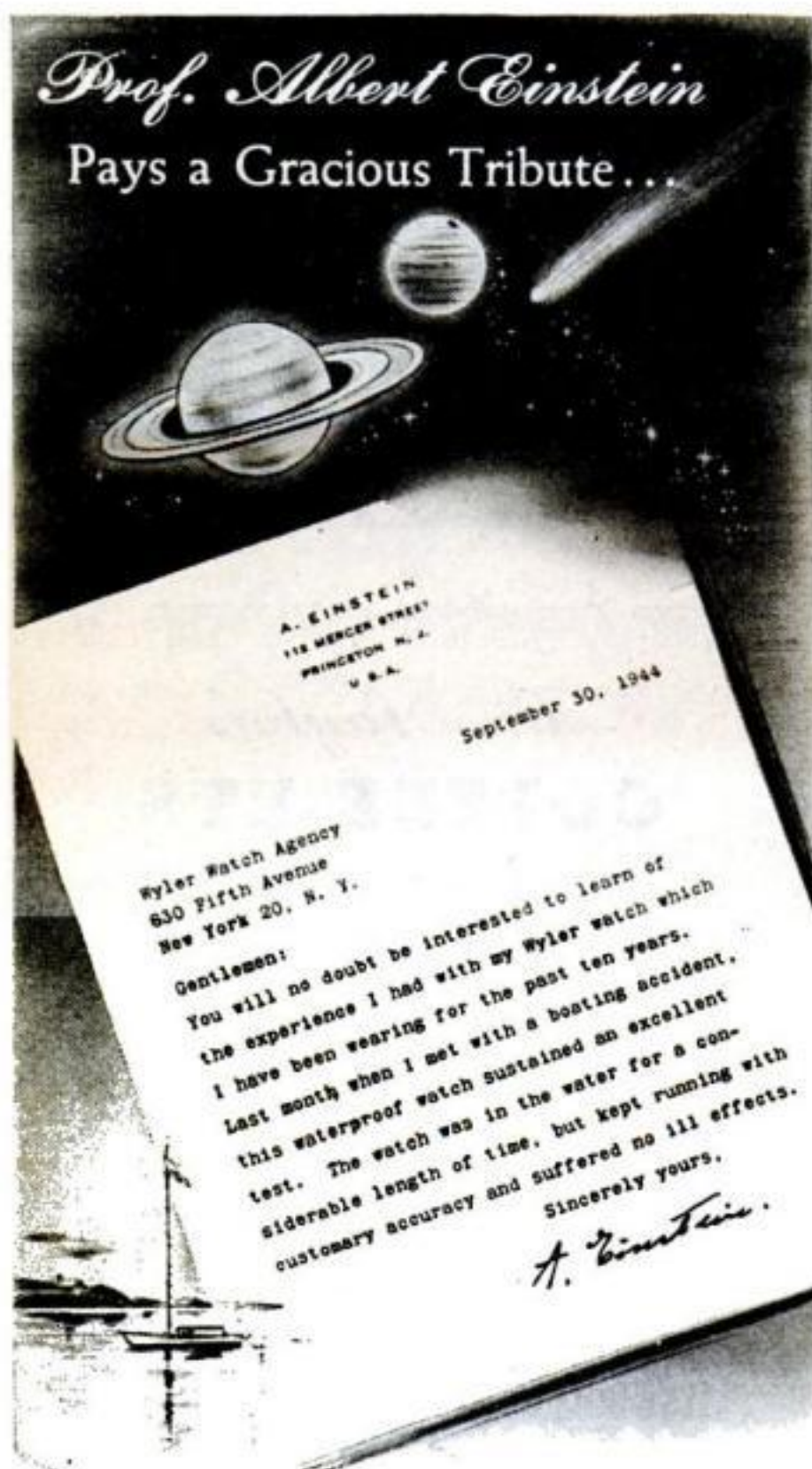
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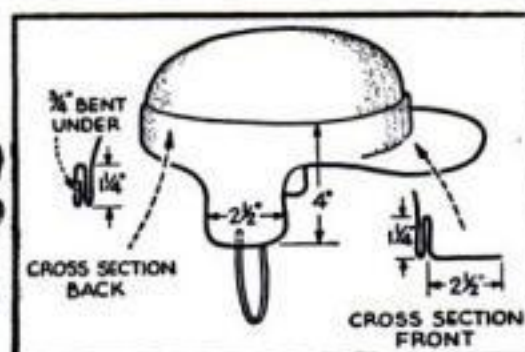
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REMOVE the ribbon and lining from a man's felt hat and fold as shown in the diagram, reducing the height of the crown and leaving the outer, downward fold 4" wide. Mark the cap front and ear flaps with chalk and cut with shears.—FRANK SHORE.

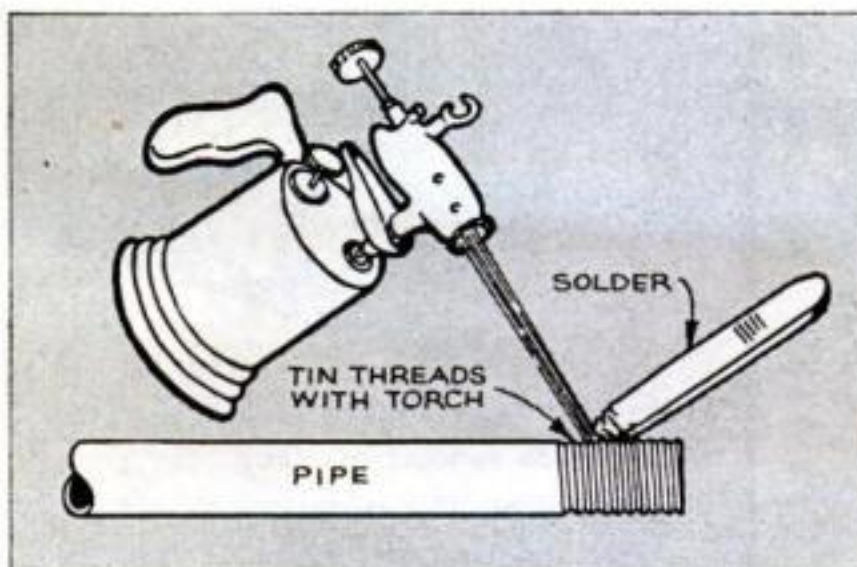
## Recutting Teeth Improves Lighter

CIGARETTE lighters often fail to spark after long use because the teeth on the steel wheel that the flint bears on have become dull. If you have a steady hand, these can be recut with a small knife-edge grinding wheel in a flexible-shaft tool or a high-speed motor tool. Be careful to recut the teeth at an angle. A magnifying glass will be helpful in cutting them evenly.—JOHN T. LEIBRAND.



## Solder Stops High-Pressure Leak

WHEN an experienced pipe fitter was told that a newly-replaced section of pipe in a high-pressure steam line was leaking around the joints, he suggested tinning the threads lightly with solder. When this was done, the line was steamtight. The solder had filled every possible bit of clearance between the pipe threads.—JOHN KRILL.





# keep collar points **DOWN!**



BEFORE



AFTER

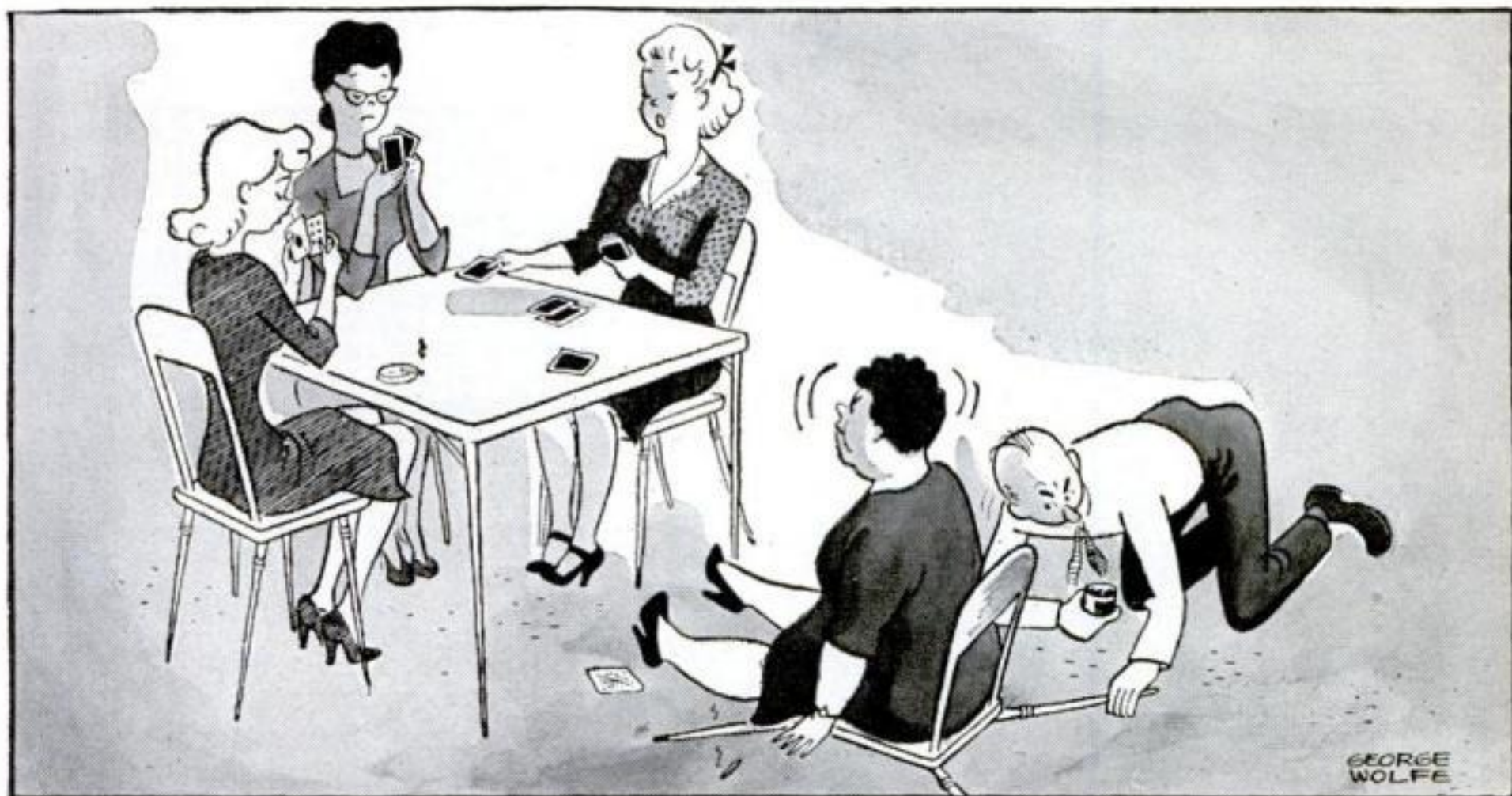
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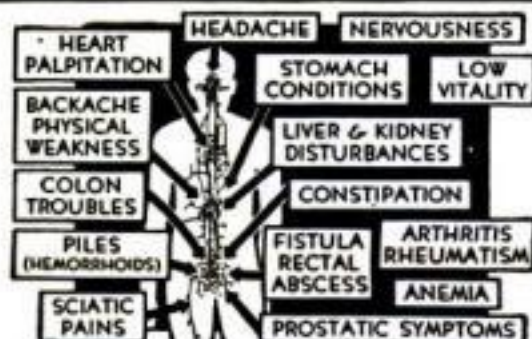


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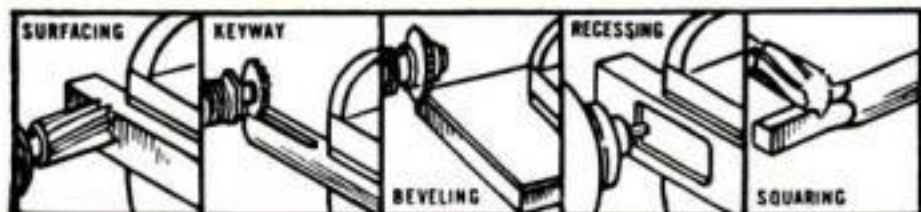
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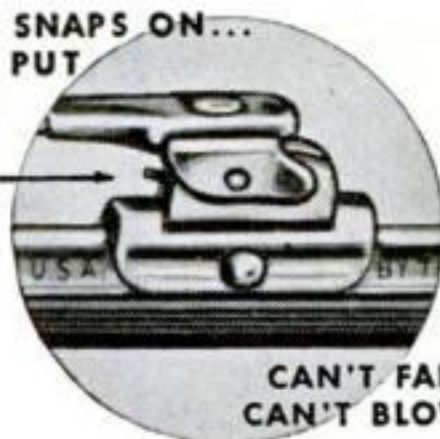
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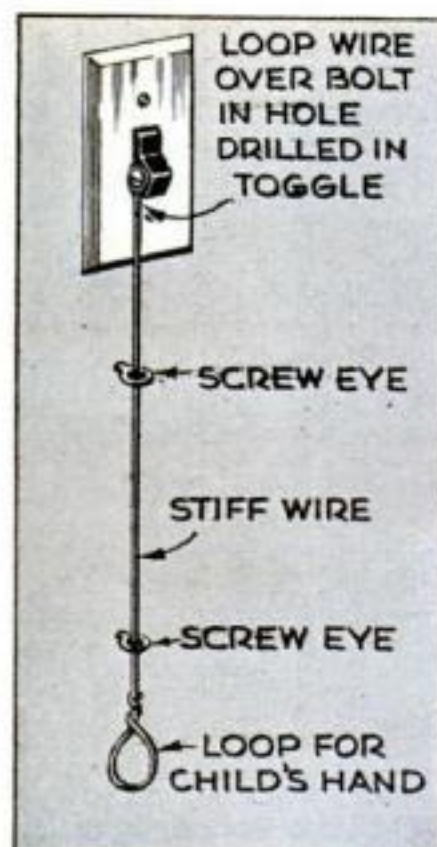
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### Wire Enables Child to Use Switch

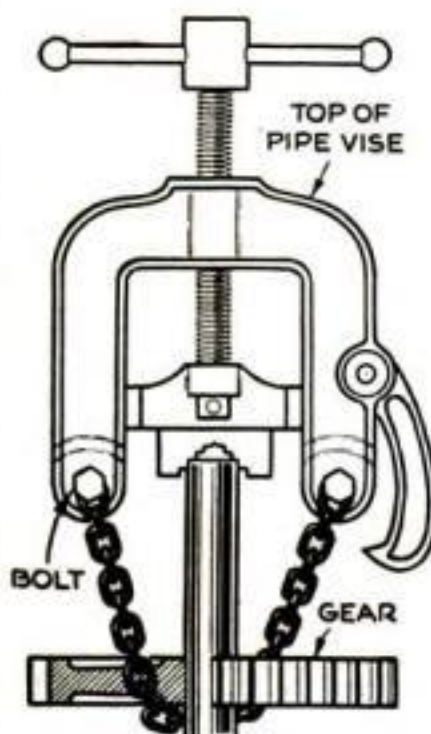
STIFF wire suspended from a toggle switch will permit a small child to turn a light on or off. Drill a hole in the toggle near the outer end and attach the wire by slipping a small bolt through the hole and an eye in the wire. Run the wire through screw eyes on the wall to keep it from bending when thrust upward.—A. ARMSTRONG.

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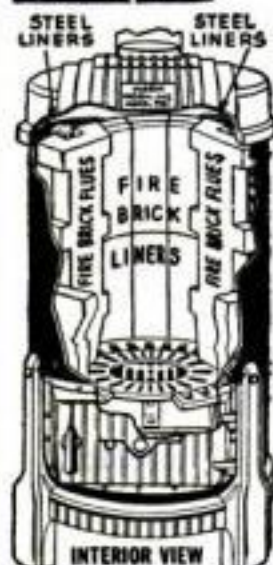
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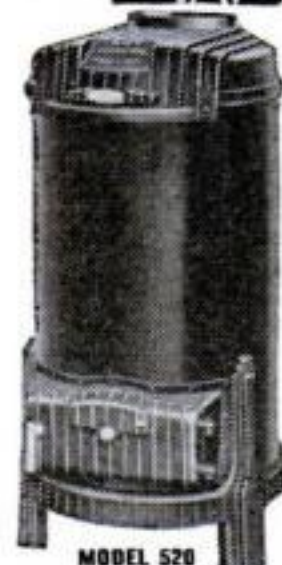
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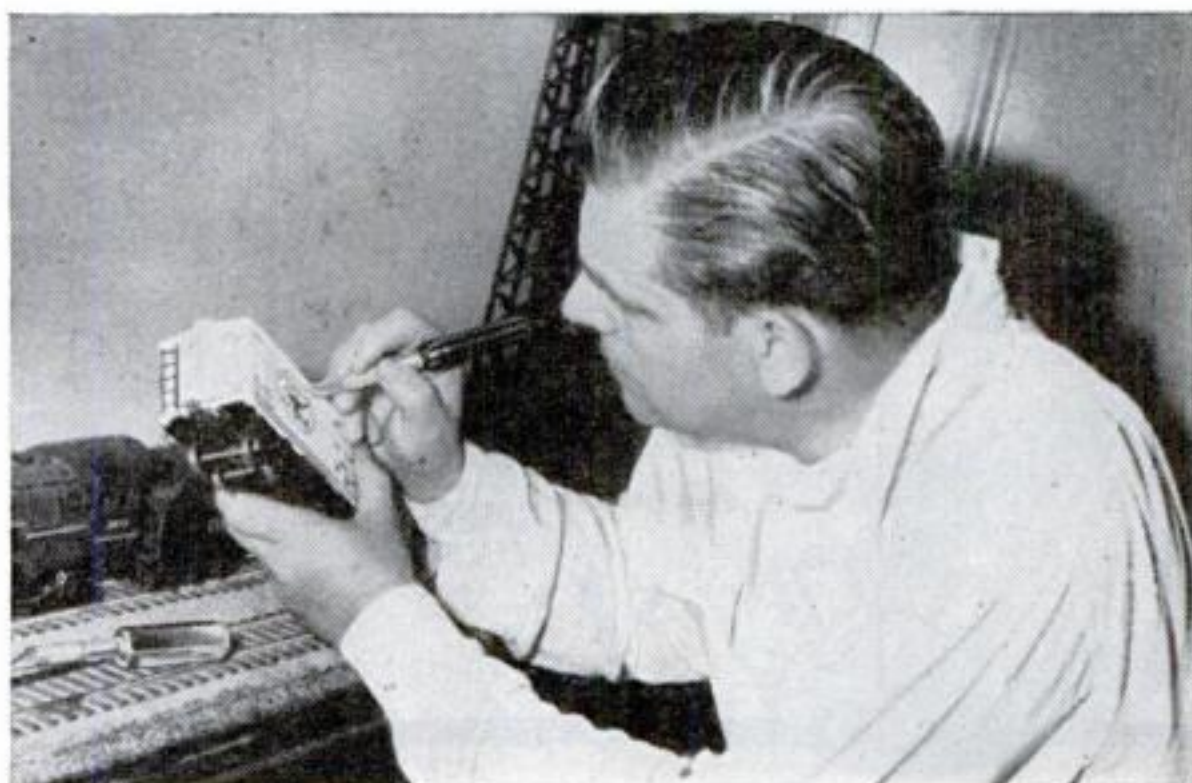
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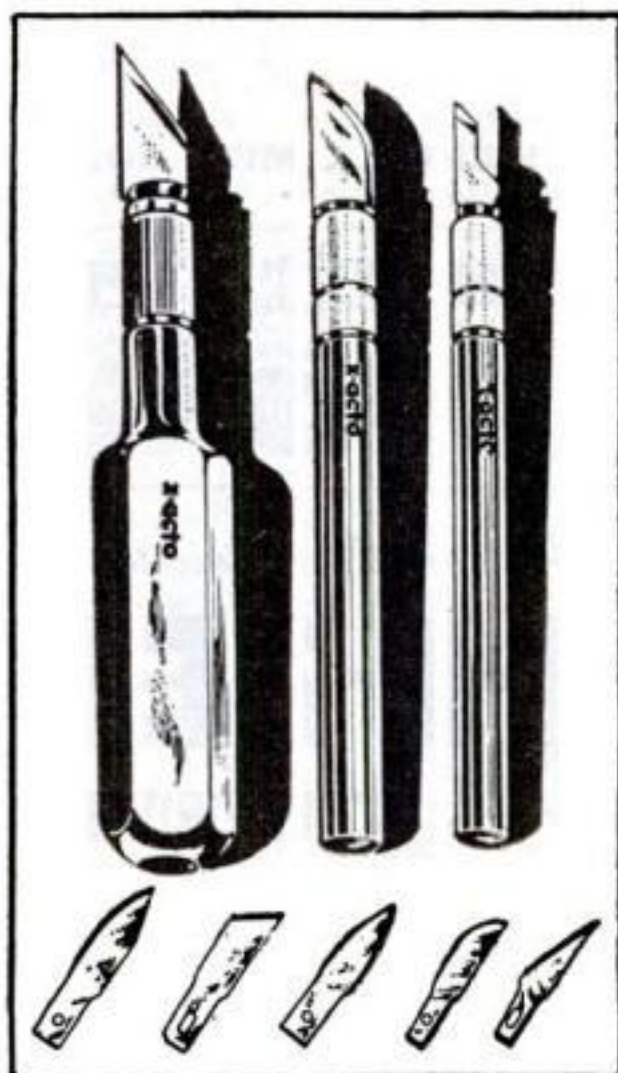


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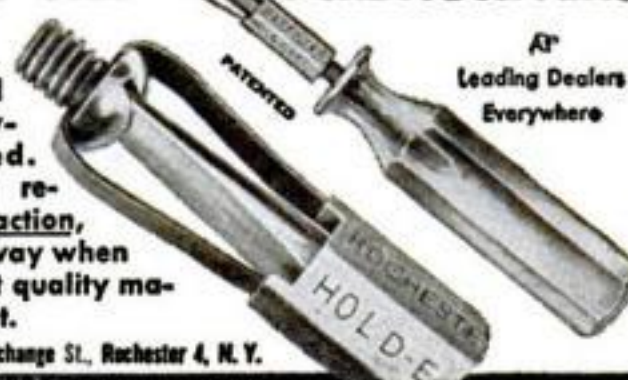
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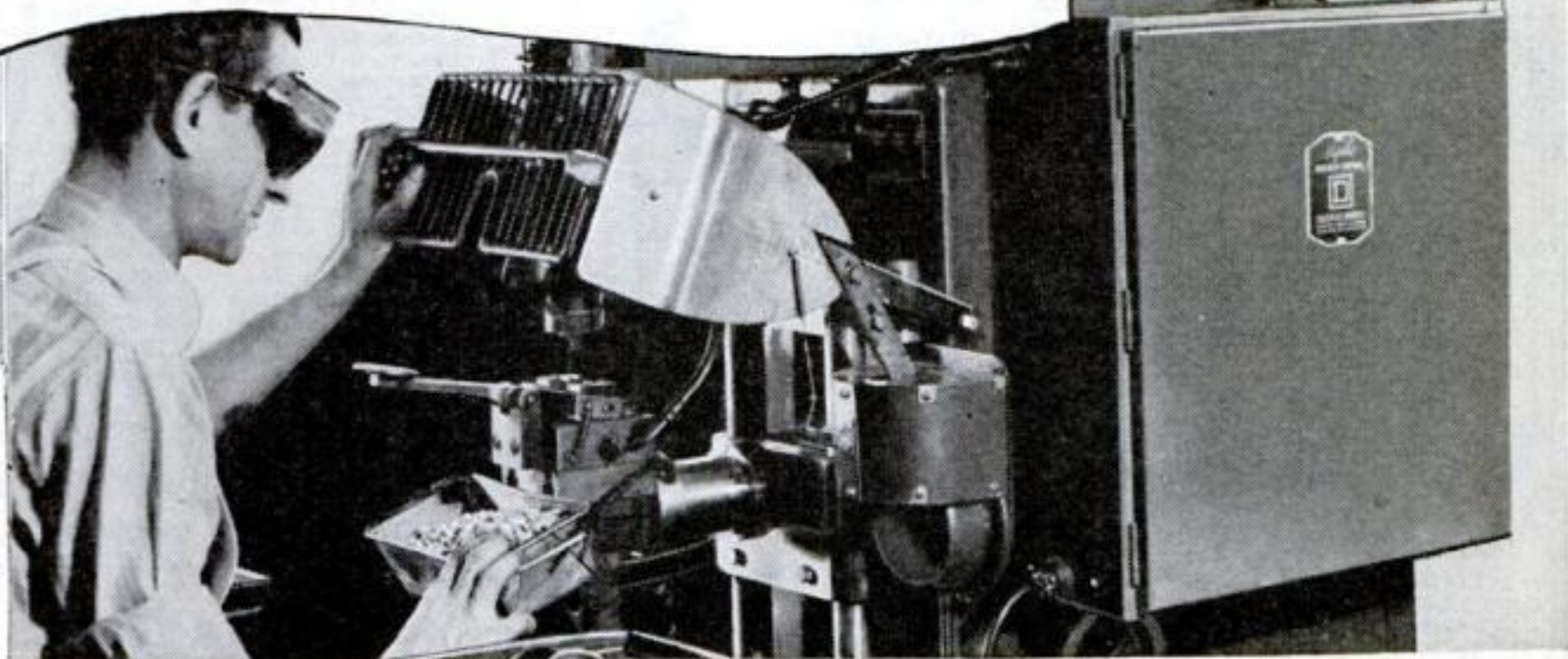


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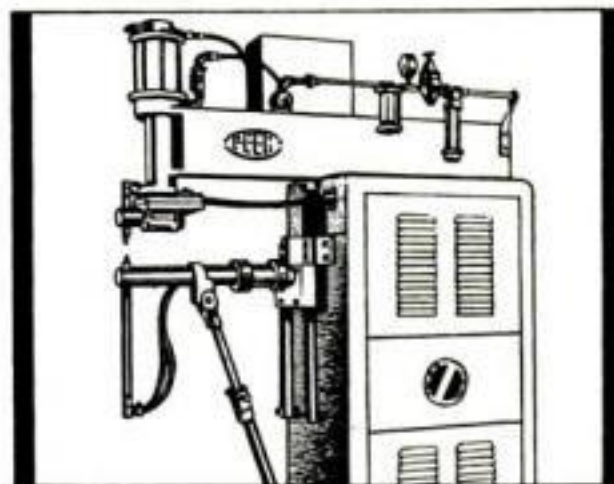
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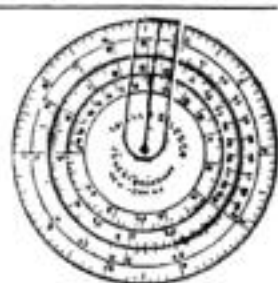
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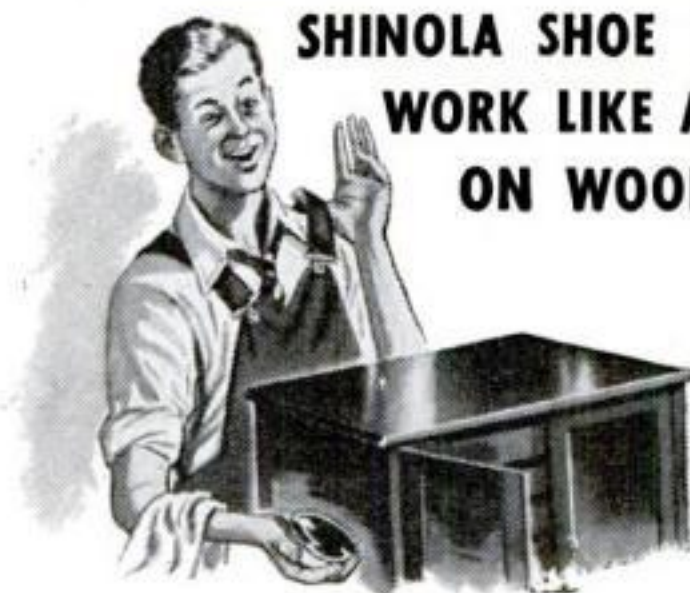
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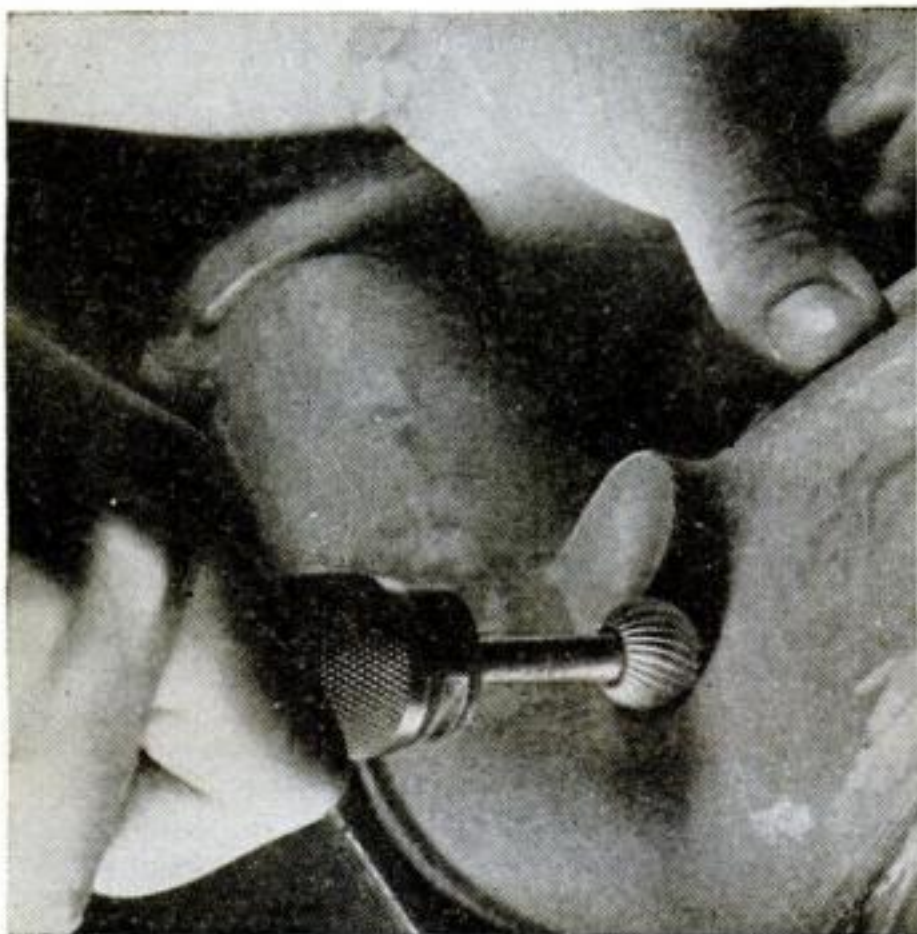
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*Liquid Hide* **GLUE**

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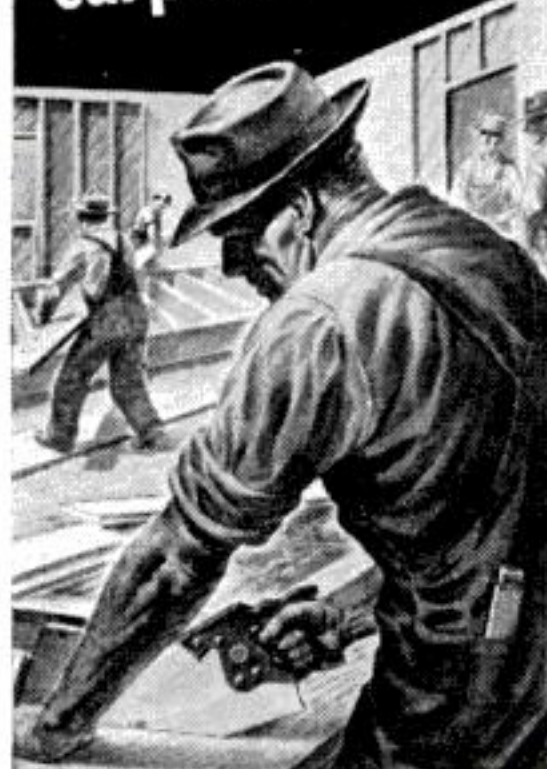
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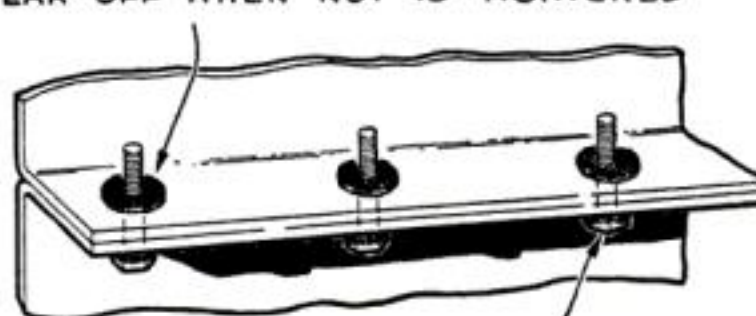
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WASHERS CUT FROM RUBBER  
TEAR OFF WHEN NUT IS TIGHTENED



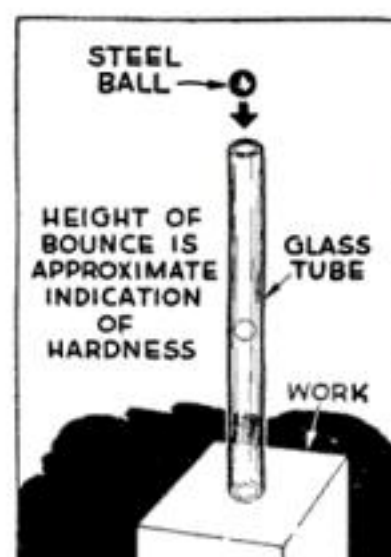
BOLTS CANNOT FALL OUT

### Bolts Are Held by Rubber Washers

SCRAPS of rubber cut from an old inner tube will keep bolts in place until you can get the nut or assembly cap into position. Punch a hole in the rubber and press it over the bolt. It will hold until you are ready for it, and tightening the nut will automatically tear the rubber away from the joint.—A. H. WAYCHOFF.

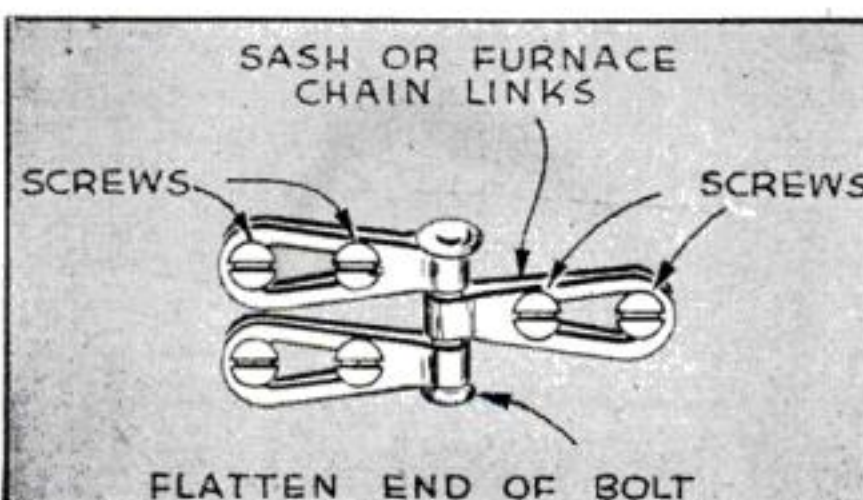
### How to Improvise a Hardness Tester

METAL hardness can be gauged accurately enough for many practical purposes by dropping a steel ball through a glass tube placed squarely on the work. The height of bounce compared with the bounce on a known metal indicates the hardness.



### Hinge Made of Furnace-Chain Links

NEAT hinges can be made out of sash or furnace-chain links as shown below. The links are connected with short bolts which are flattened at one end with a hammer. Mortise the edge against which the hinges are to be used so that the door or cover will close properly. Two screws may be used in each link opening. Wider hinges can be made by adding extra links.—F. S.











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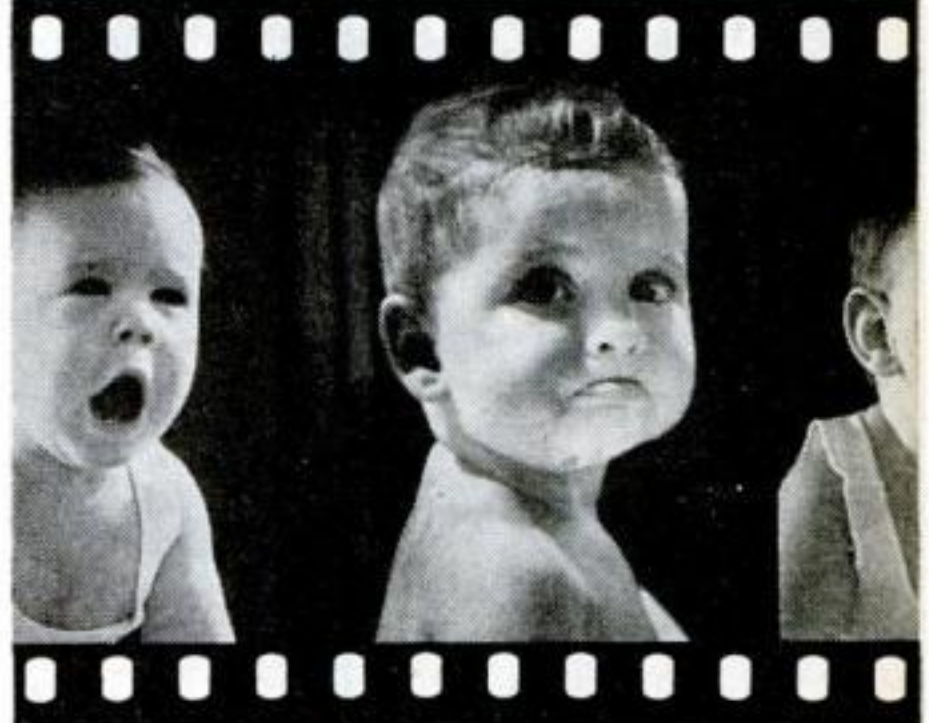
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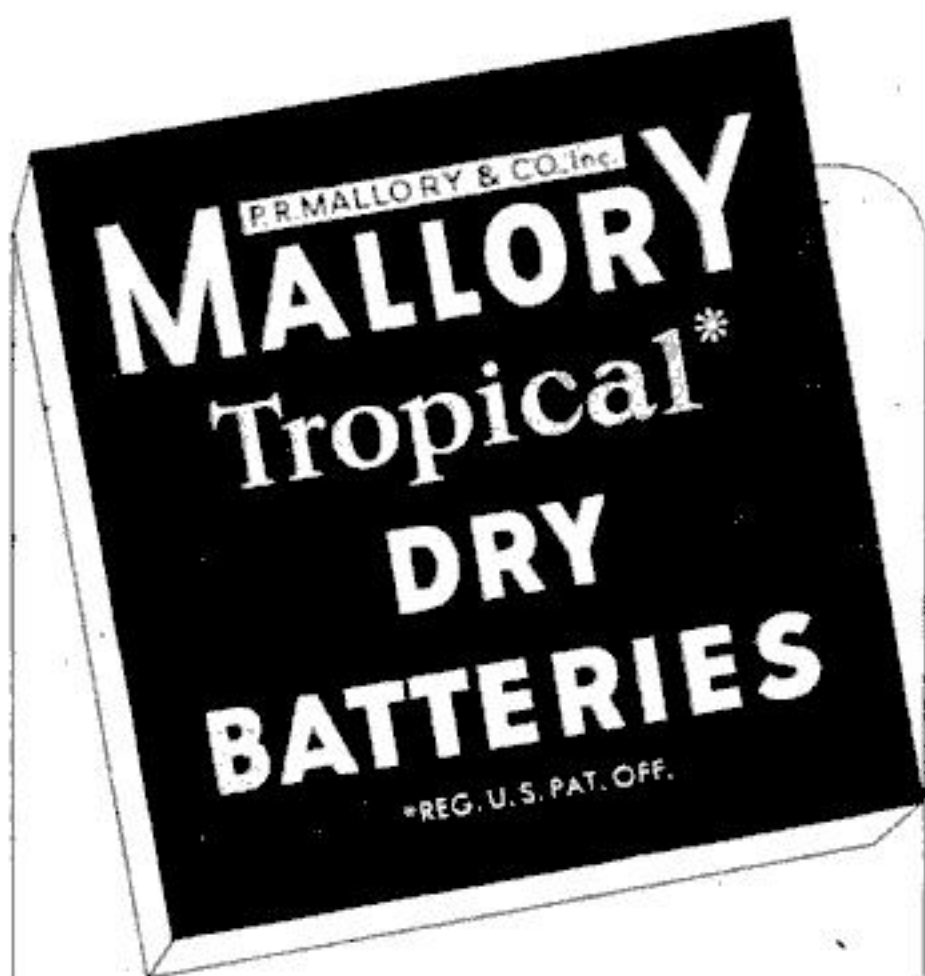
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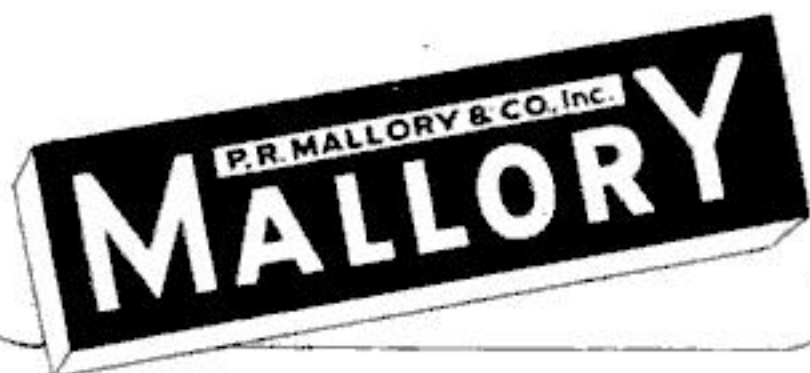


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## Jobs for Surplus War Goods

*(Continued from page 77)*

on small farms and in semisuburban areas. A good many electricians and radio men dream of having trailer shops in which to do on-the-spot repair and service work in their home areas. David M. Wilkinson, of Norwalk, Conn., believes that one of the Army's land-mine locators would be of great help in the plumbing business; he would use it to trace underground water pipes and sewer lines.

Any number of items, of course, can be sold in small quantities to the ingenious owners of home workshops. Pottery bowls and jugs can be made into decorative lamps. Airplane pistons can be cut down into attractive ash trays, and airplane connecting rods need only a little imagination to be converted into beautiful, modern andirons. There's no end to the possible uses for plastic windshields and windows from junked planes. All kinds of metal tubing will go into door chimes, vases, flower stands, racks, book ends, and ultramodern furniture. Aircraft sheet metal will be spun and hammered into bowls and trays of every size and shape. And the home craftsmen, of course, will be avid purchasers of the surplus tools, both power and hand, and of whatever hardware and small supplies may be available to them. Not the least of their demand will be for the compact, high-powered electric motors developed for aircraft use; those motors will seem specially designed for their basement or back-room shops, where space appears to be always at a premium.

Obviously, the Government cannot sell this surplus material piecemeal to individual purchasers; that would take years and hundreds of retail salesrooms. The policy has been to sell it in as large lots as possible, preferably to small retailers. Exceptions have included farm machinery, sold at public auction in farming areas, and airplanes, sold to individual purchasers under a special setup. But the great bulk of this material will be made available only through established retailers.

From the Government viewpoint, the problem is to dispose of this material as quickly and as simply as possible and with the least disruption of private business. There is no doubt that the ultimate consumers, ingenious Americans everywhere, will find good use for most of these figurative swords and spears of modern war. Yes, even for the bazooka, which may be firing salvos of display rockets into the skies of freedom next July Fourth.





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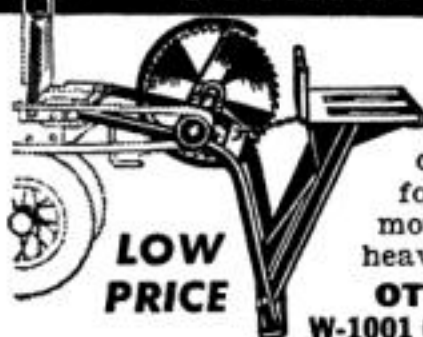
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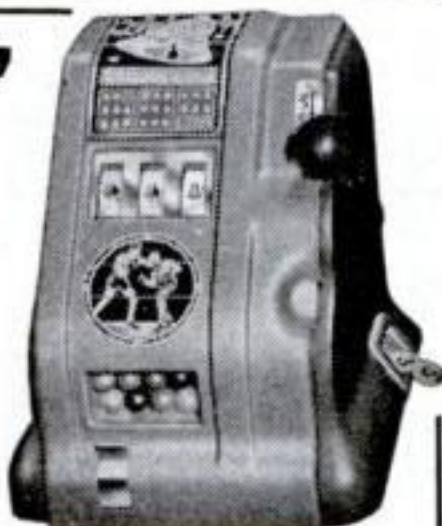
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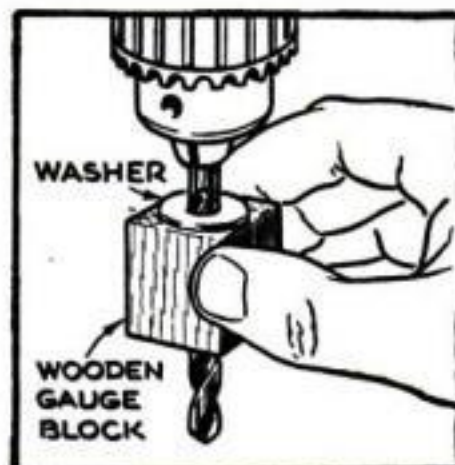


## Applicator for Scribing Stain

ALCOHOLIC stain, used to make scribing marks more legible, can be applied with a small applicator bottle of the type sold with cleaning fluids and spot removers. Pass the saturated fabric cap over the work once for a smooth, even stain.—KENNETH MURRAY.

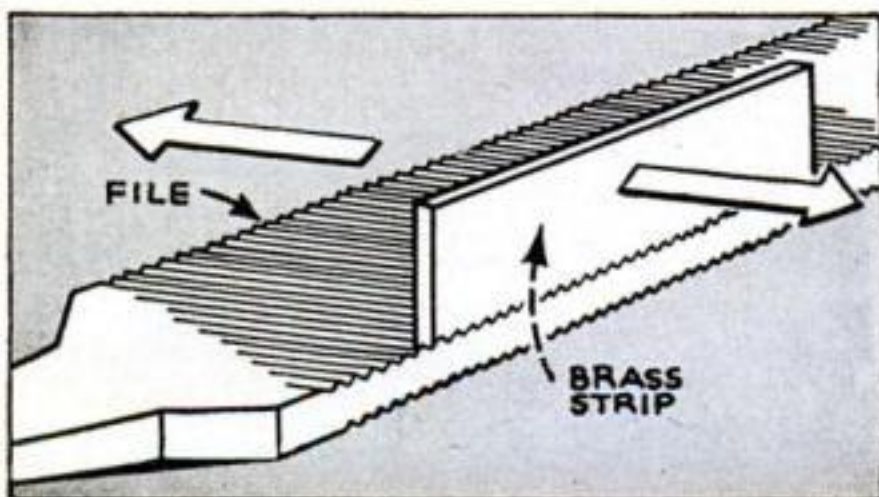
## Washer Saves Wear on Gauge Block

WHEN drilling a number of similar holes with the aid of a wooden gauge block, slip a washer on the drill above the block to prevent the chuck jaws from eating into and wearing away the wood.

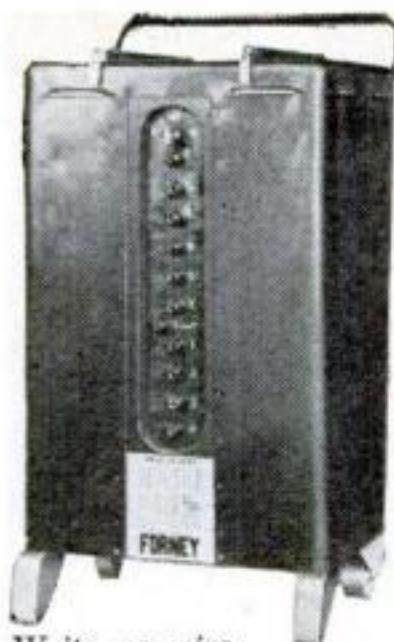


## Brass Strip Cleans Teeth of File

CLOGGED file teeth can often be cleaned effectively with a strip of brass. Draw the edge of the strip across the file several times in the same way that the teeth run. Corresponding notches will be cut into the brass that will allow the strip to remove the clogging material.—K. M.







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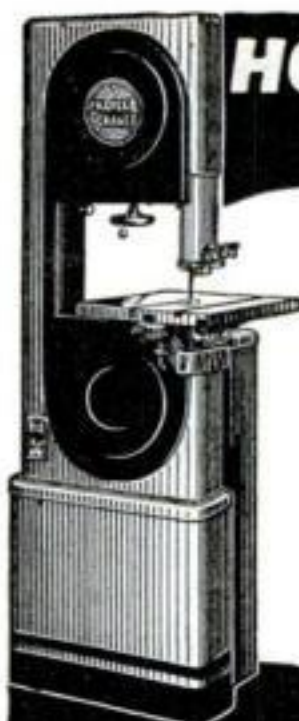
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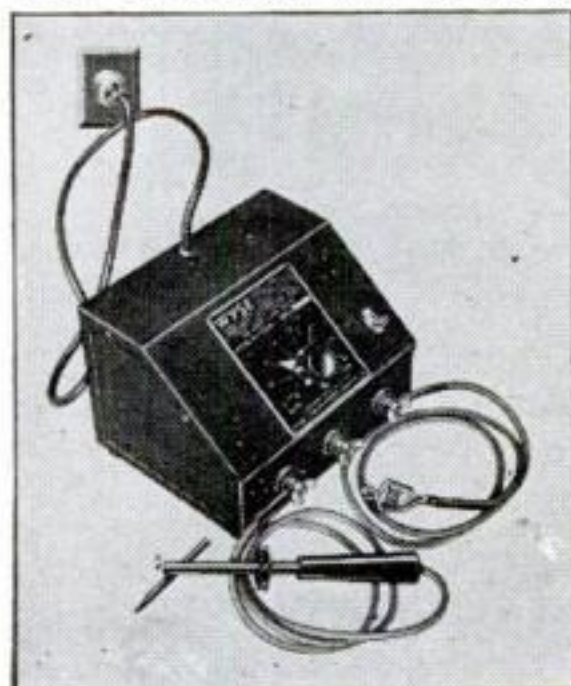
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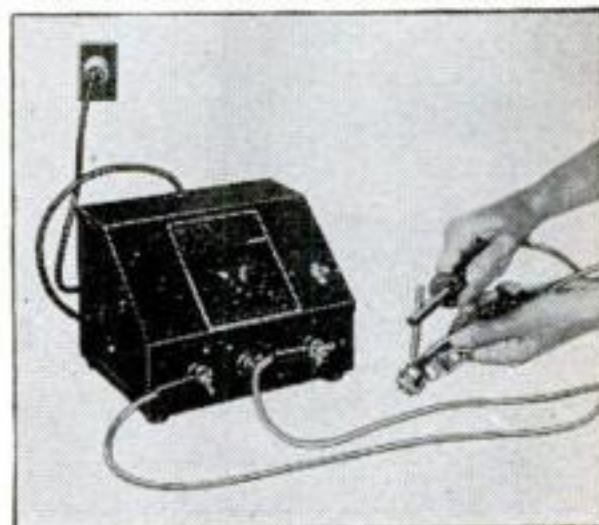
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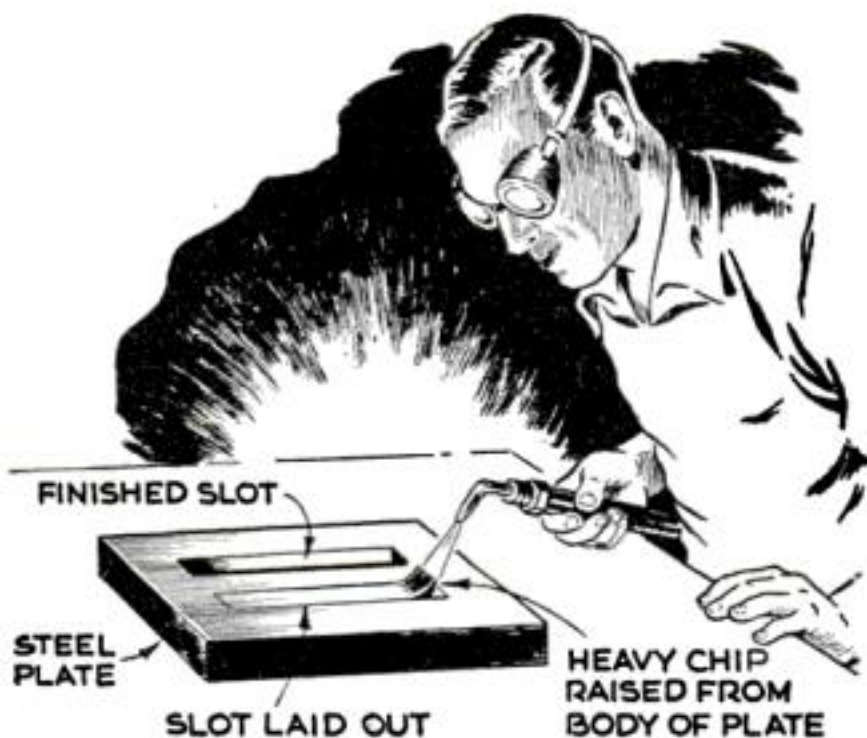
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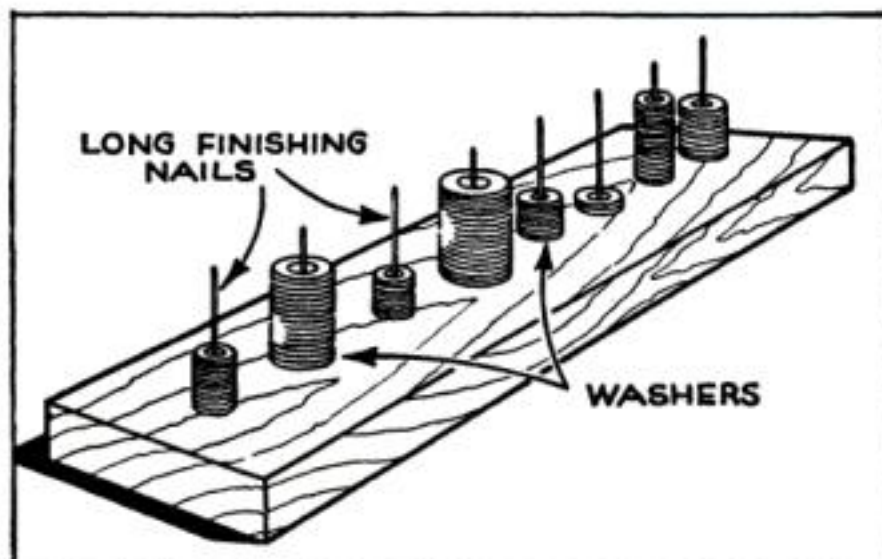
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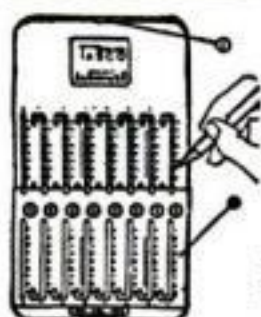


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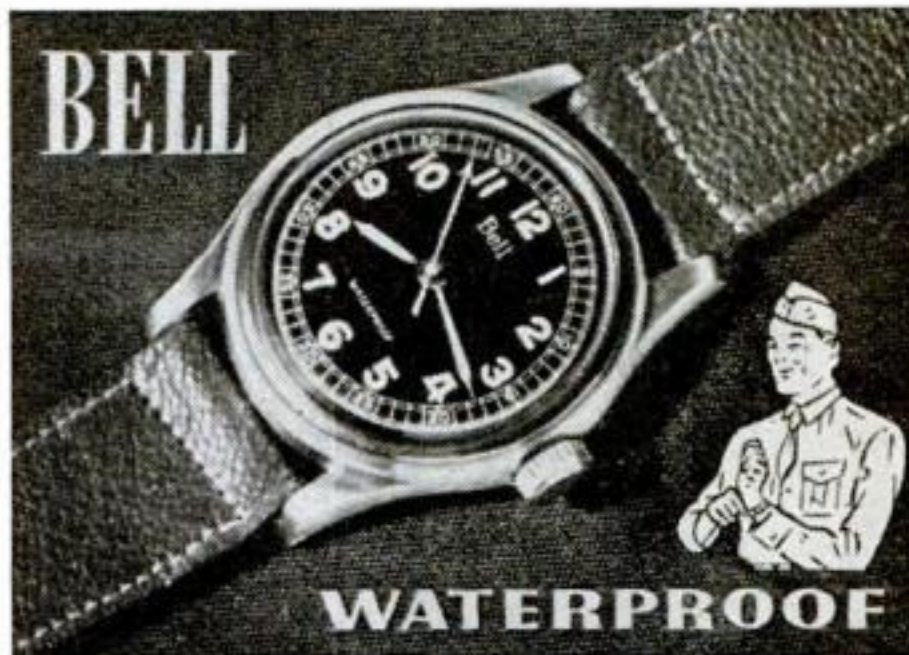


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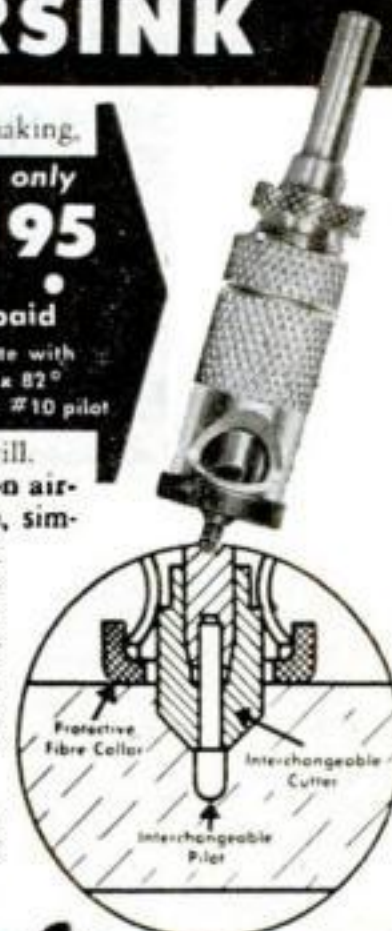
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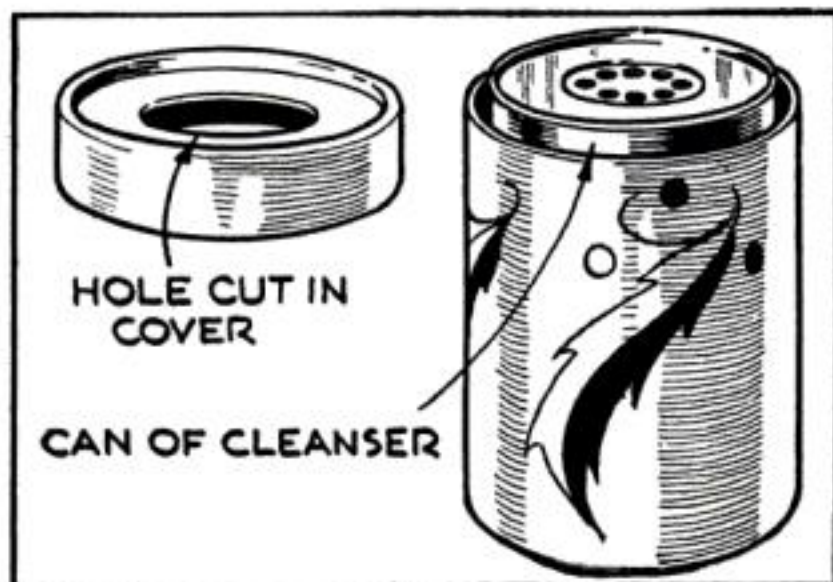
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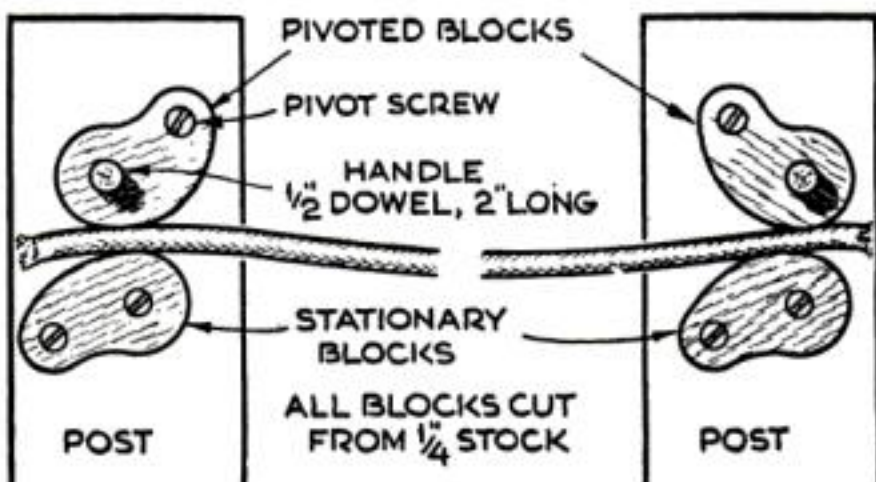
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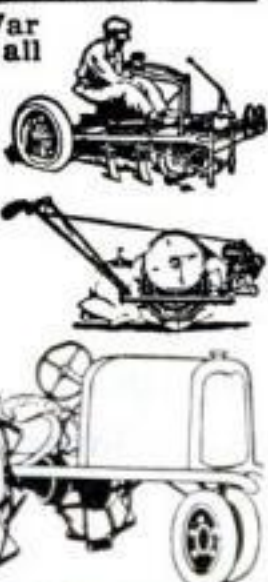
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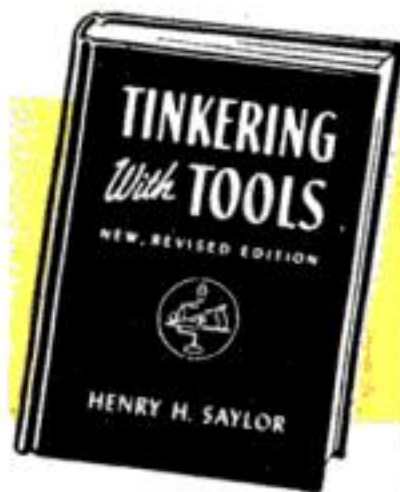
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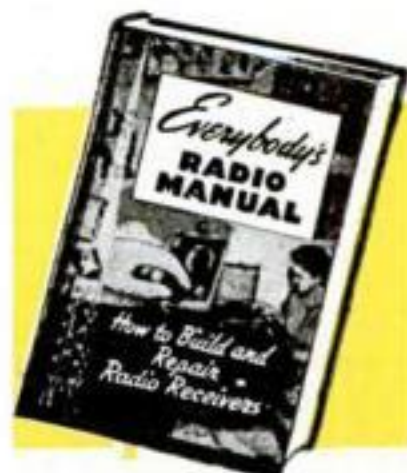
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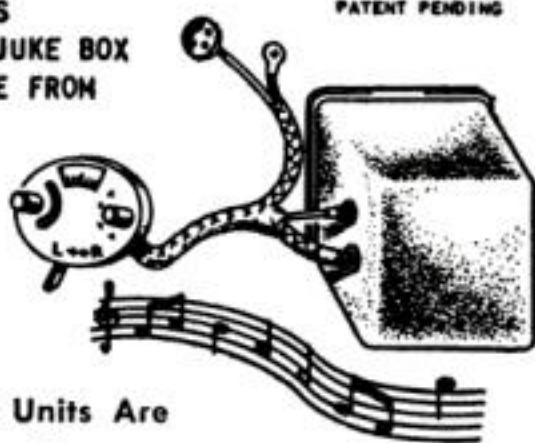
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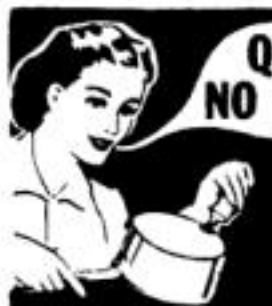
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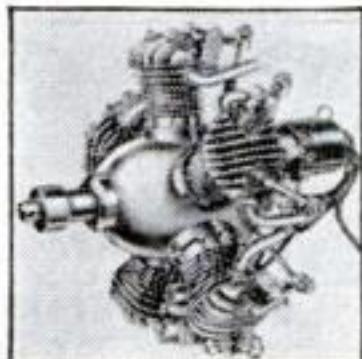
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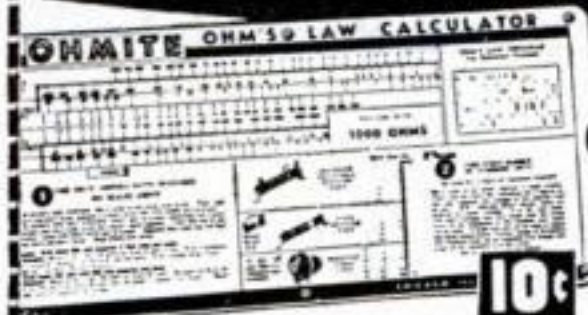
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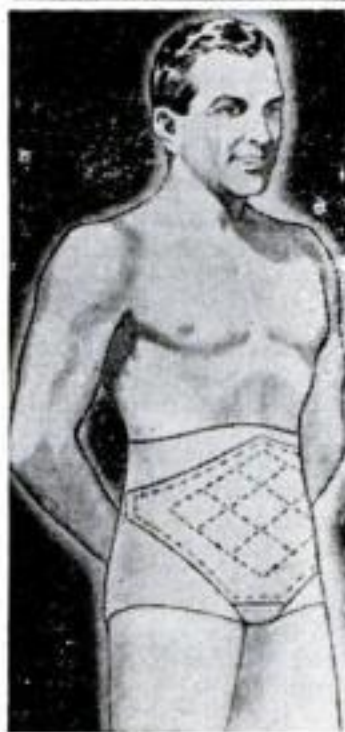
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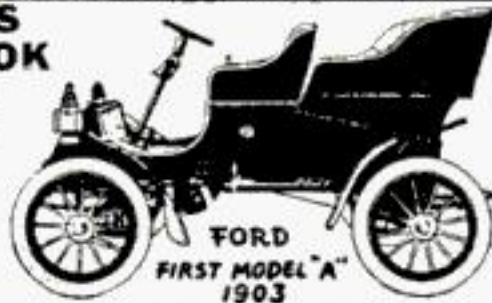
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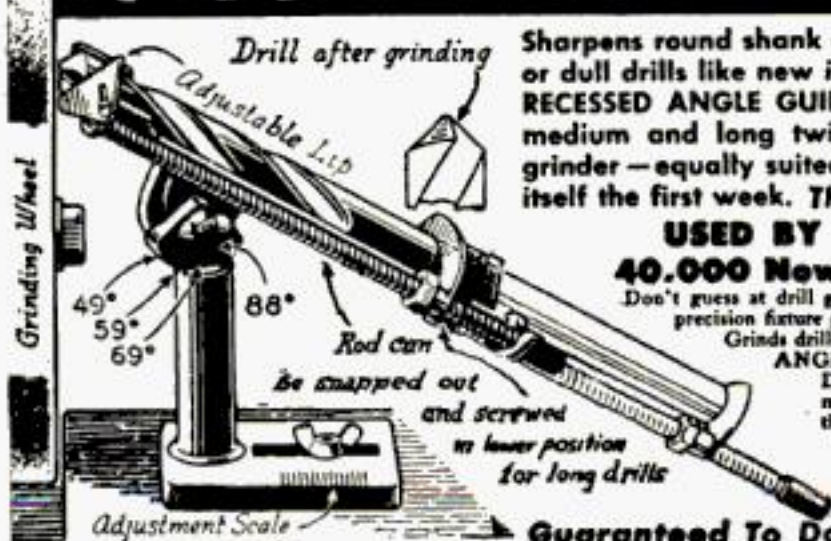
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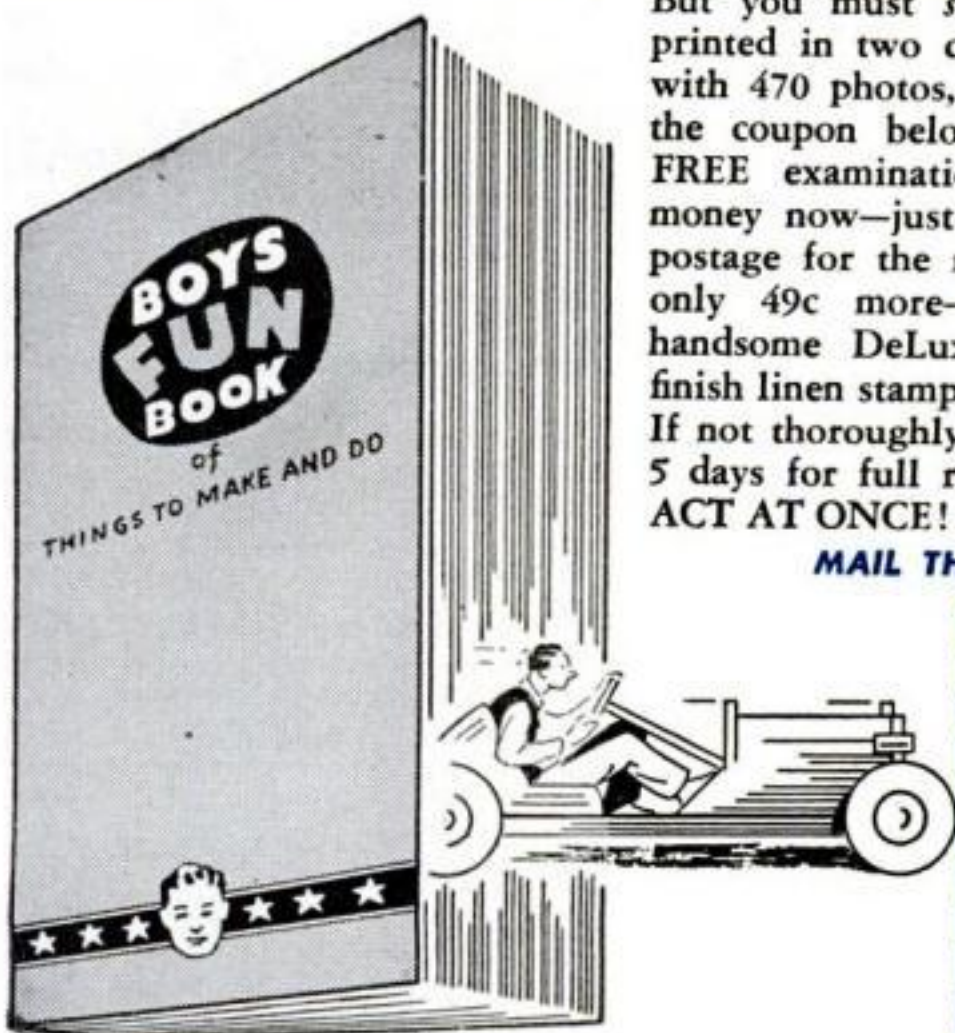
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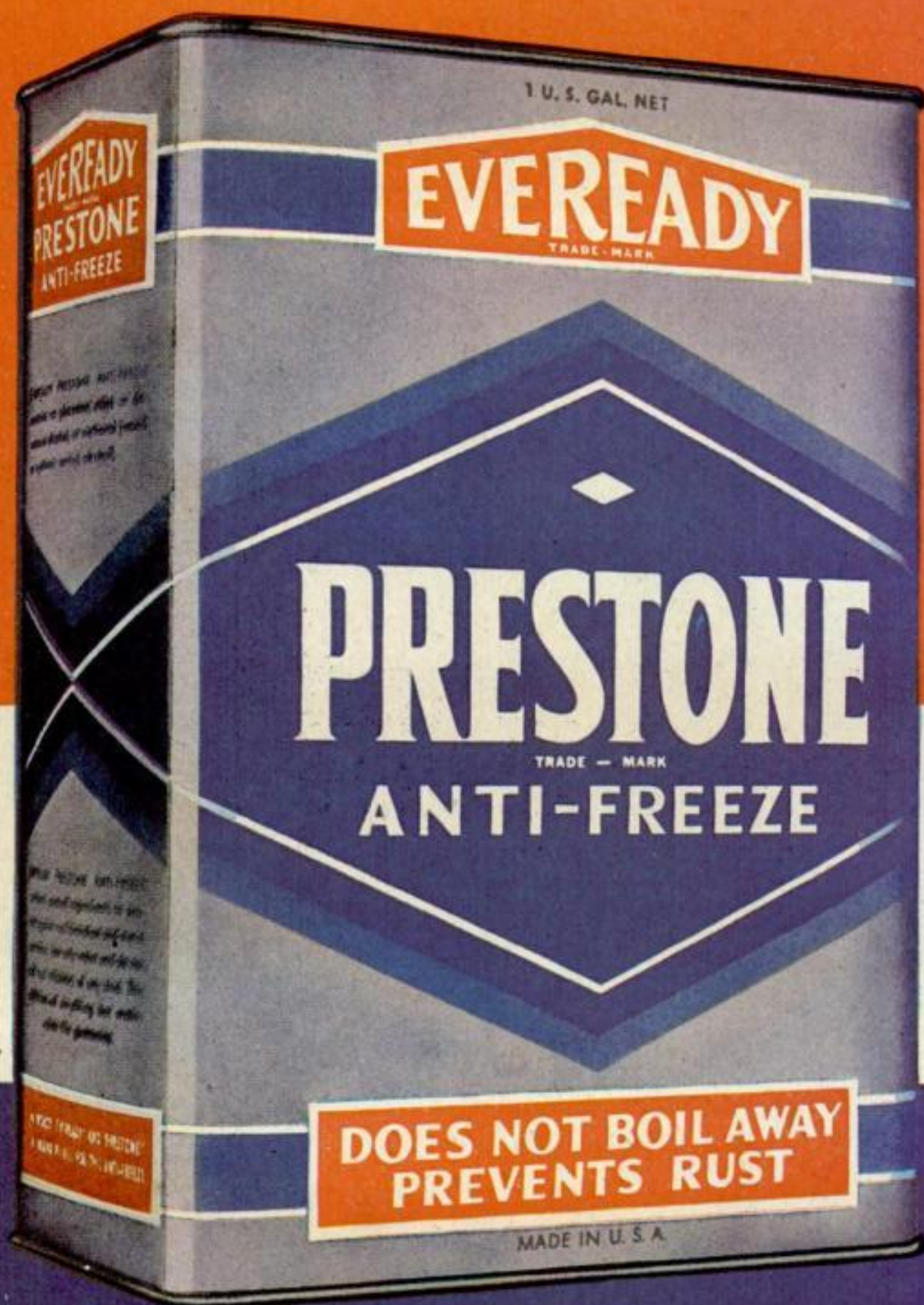
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